

NOTICES

OF THE

AMERICAN MATHEMATICAL SOCIETY

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Calendar of AMS Meetings and Conferences

This calendar lists all meetings and conferences approved prior to the date this issue went to press. The summer and annual meetings are joint meetings of the Mathematical Association of America and the American Mathematical Society. The meeting dates which fall rather far in the future are subject to change; this is particularly true of meetings to which no numbers have been assigned. *Programs* of the meetings will appear in the issues indicated below. *First and supplementary* announcements of the meetings will have appeared in earlier issues. **Abstracts of papers** presented at a meeting of the Society are published in the journal *Abstracts of papers presented to the American Mathematical Society* in the issue corresponding to that of the *Notices* which contains the program of the meeting,

insofar as is possible. Abstracts should be submitted on special forms which are available in many departments of mathematics and from the headquarters office of the Society. Abstracts of papers to be presented at the meeting must be received at the headquarters of the Society in Providence, Rhode Island, on or before the deadline given below for the meeting. The abstract deadlines listed below should be carefully reviewed since an abstract deadline may expire before publication of a first announcement. Note that the deadline for abstracts for consideration for presentation at special sessions is usually three weeks earlier than that specified below. For additional information, consult the meeting announcements and the list of special sessions.

Meetings

Meeting #	Date	Place	Abstract Deadline	Program Issue
876	* October 30–November 1, 1992	Dayton, Ohio	Expired	October
877	* November 7–8, 1992	Los Angeles, California	Expired	October
878	* January 13–16, 1993 (99th Annual Meeting)	San Antonio, Texas	October 8	December
879	* March 26–27, 1993	Knoxville, Tennessee	January 5	March
880	* April 9–10, 1993	Salt Lake City, Utah	January 29	April
881	* April 17–18, 1993	Washington, D.C.	January 29	April
882	* May 21–22, 1993	DeKalb, Illinois	February 26	May–June
883	* August 15–19, 1993 (96th Summer Meeting) (Joint Meeting with the Canadian Mathematical Society)	Vancouver, British Columbia	May 18	July–August
884	* September 18–19, 1993	Syracuse, New York	May 18	September
885	* October 1–3, 1993 (Joint Meeting with the Deutsche Mathematiker-Vereinigung e.V.)	Heidelberg, Germany		
	October 22–23, 1993	College Station, Texas		
	January 12–15, 1994 (100th Annual Meeting)	Cincinnati, Ohio		
	March 18–19, 1994	Lexington, Kentucky		
	March 25–26, 1994	Manhattan, Kansas		
	June 16–18, 1994	Eugene, Oregon		
	October 28–29, 1994	Stillwater, Oklahoma		
	January 25–28, 1995 (101st Annual Meeting)	Denver, Colorado		
	March 24–25, 1995	Chicago, Illinois		
	January 10–13, 1996 (102nd Annual Meeting)	Orlando, Florida		
	March 22–23, 1996	Iowa City, Iowa		

* Please refer to page 760 for listing of Special Sessions.

Conferences

January 11–12, 1993: AMS Short Course on Wavelets and Applications, San Antonio, Texas.

Deadlines

	November Issue	December Issue	January Issue	February Issue
Classified Ads*	October 1, 1992	November 13, 1992	December 10, 1992	January 7, 1993
News Items	September 21, 1992	October 29, 1992	December 2, 1992	December 24, 1992
Meeting Announcements**	September 21, 1992	October 29, 1992	December 2, 1992	December 24, 1992

* Please contact AMS Advertising Department for an Advertising Rate Card for display advertising deadlines.

** For material to appear in the Mathematical Sciences Meetings and Conferences section.

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OF THE

AMERICAN MATHEMATICAL SOCIETY

ARTICLES

684 Deane Montgomery (1909–1992) *Armand Borel*

This article pays tribute to the life and career of former AMS President Deane Montgomery, a distinguished topologist and longtime member of the Institute for Advanced Study.

688 Sloan Foundation Joins AMS to Aid Mathematics in the former Soviet Union

The Sloan Foundation has awarded the Society a \$30,000 challenge grant to support the AMS program to assist mathematics in the former Soviet Union. Allyn Jackson describes the assistance program, and an accompanying announcement provides information on how to contribute to this important effort.

689 European Meetings Bring Mathematicians Together

A number of historic “firsts” took place in Europe this summer—the joint AMS meeting with the London Mathematical Society in Cambridge, England; the opening of the Isaac Newton Institute in Cambridge; and the first European Congress of Mathematics, held in Paris. Allyn Jackson reports on these events.

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696 Computers and Mathematics *Keith Devlin*

Andrew Granville writes an expository article based on his paper *There are infinitely many Carmichael numbers*, cowritten with Red Alford and Carl Pomerance. Following Granville’s piece, Barry Simon presents the results of a series of benchmark tests he has run on a number of computer mathematics systems.

711 Inside the AMS

Alice Schafer, Chair of the AMS Committee on Human Rights of Mathematicians, reports on the Committee’s activities and accomplishments over the past two years.

712 Washington Outlook

Lisa Thompson discusses how the government allocates resources among the various elements of the scientific enterprise.

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OF THE

AMERICAN MATHEMATICAL SOCIETY

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From the Executive Director . . .

RESOURCES FOR EXCELLENCE

There have been numerous national reports pointing out the need for the renewal of academic mathematical sciences departments. The reports call upon the departments to maintain the tradition of first class research; reform mathematics education at all levels; revise the curriculum to introduce experimental classes, varied instructional approaches, and new technologies; become involved in teacher enhancement and preparation; engage in interdisciplinary activity and university service; increase the participation of underrepresented minorities and women; and contribute to economic competitiveness. This is only a partial list. Information is available, in varying degrees of detail and clarity, as to how to go about doing all these things.

These reports have been useful in providing a springboard for debate, in distributing important information, and in outlining means for change. However, it is time to move beyond the reports and into action, and mathematical sciences departments are the natural institutions to take actions to bring about substantial, long-term change within the community. There is general agreement on what needs to be done, and there are laudable examples of activities of individuals, groups, and departments that are doing exciting things. But, is the academic mathematical sciences community positioned to respond? Does this community have the resources (or the political sophistication to get them) necessary to meet these challenges and opportunities?

Mathematical sciences departments, on the whole, are not viewed as major players in acquiring academic resources. There is a history of little attention being paid to the political avenues by which mathematical sciences departments might position themselves more favorably. The current challenges and opportunities come at a time when there is a shortage of federal research funds and there is a depressed economy that is affecting academic finances. Indeed, department resources are vulnerable to serious cuts. Distressed departments cannot respond adequately to the new challenges confronting them. Faculty, staff (including technical assistance), appropriate space, computers and networking, libraries, instructional labs, and research and travel funds are just some of the resources necessary for departments to respond to the recommendations that are being made. How can we make the case for adequate academic resources for mathematics? How does a department determine what will work or, recognizing the limitations on its resources, what resources are needed to be successful in meeting the challenges? These are issues that the reports leave unanswered.

The mathematical sciences are generally seen as important to education, research, and the mission of the university. In addition, there is widespread concern over low student retention in entry-level mathematics courses because it affects not only science and engineering career paths, but also overall retention at the university. However, these points will not suffice to make the case for improving resources for mathematical sciences departments. We need solid evidence with data and arguments about what works and what does not work. We need to set forth measurable expectations and articulate the case that changes will result from increased resources.

The Society is engaged in an intense examination of how it might be able to help the academic mathematical sciences community confront these issues. Can we provide information and assistance to academic departments in planning and in articulating the case for necessary resources?

An AMS Task Force is being formed to address these questions and to try to provide academic departments with a description of what activities are finding success and what resources are necessary to meet the challenges departments face. It is expected that usable data will be part of the outcome of this work. The Task Force will be working with other organizations in order to coordinate related activities. Continued coverage of the work of the Task Force will be in the *Notices*. The community's advice and comments are needed and welcome.

William Jaco

Letters to the Editor

Shafarevich Responds to Open Letter

Editor's Note: The following is a response to the Open Letter to I. R. Shafarevich which appeared in the advertisements section of the March 1992 issue of the *Notices*. Both the Open Letter and the response below refer to Shafarevich's work *Russophobia* [published by the Russischer Nationaler Verein, München, Germany, 1989; the latest version was published by Sovetskii Pisatel, Moscow, 1991]

Dear Colleagues,

I was deeply upset by your letter. In the years of our dissident struggle in the USSR, many of us looked at the U.S. as a kind of "Existenzbeweis"—a proof of existence of solution of the problem we aimed to solve: to establish a society where speech and thought are free. Unfortunately this letter of yours reminds me of numerous letters addressed in our country to Solzhenitzin, Pasternak, and Sakharov at that time. Not that I compare myself with one of those people, but the whole spirit of the letter is the same.

For instance you allude to "anti-semitic" sentiment in my paper. In this paper I tried to show that "anti-semitism" is an empty political slogan

left deliberately vague just as the accusation in "anti-sovietism" so familiar to me. Still you do not try to make your accusations precise. Change "anti-semitism" to "anti-sovietism" and your letter will become one of those hatred-letters in our country 20 years ago.

You predict the effect of my paper on my interactions with other mathematicians. Are you authorized by them to express their feelings? In those letters in our country the authors also usually used to speak on behalf of "Progressive mankind" or at least "All soviet scientists"

Without burdening yourself with arguments, you demand my public disclaimer of my views (which you call "anti-semitic polemic")—that is the procedure that was so common during the purges under the communist regime in the USSR.

You attribute to me the "conspiratorial theory" which I certainly do not share (if only you do not broaden the notion of "conspiracy" in such a way as to consider e.g., the annihilation of North American Indians to be a conspiracy of English settlers). You certainly could see it from my paper, should you read it. But I have serious doubts about many of you having read it. I know personally many of those signed the letter who do not read Russian. While there is only a pirate English translation of the paper—without my authorization and supervision, I leave it to you to decide about the legal and moral character of such edition and about references to it.

Again it is very much like the letters to Sakharov in USSR; "I have not read this slander but I despise it..."

My last question is to the people who signed the letter and whom I knew 15 or 20 years ago as soviet mathematicians. Living in USSR they witnessed the deportation of Solzhenitzin, exile of Sakharov, persecution of religion, detention of sane persons in psychiatric hospitals for political reasons. We haven't heard their protests against it then. Do they really believe that my paper is more dangerous?

Respectfully yours,

I. R. Shafarevich
Mathematical Institute of the
Russian Academy of Sciences
(Received July 20, 1992)

Letters to the Editor

Letters submitted for publication in the *Notices* are reviewed by the Editorial Committee.

The *Notices* does not ordinarily publish complaints about reviews of books or articles, although rebuttals and correspondence concerning reviews in *Bulletin of the American Mathematical Society* will be considered for publication.

Letters should be typed and in legible form or they will be returned to the sender, possibly resulting in a delay of publication. All published letters must include the name of the author. Letters which have been, or may be, published elsewhere will be considered, but the Managing Editor of the *Notices* should be informed of this fact when the letter is submitted.

The committee reserves the right to edit letters.

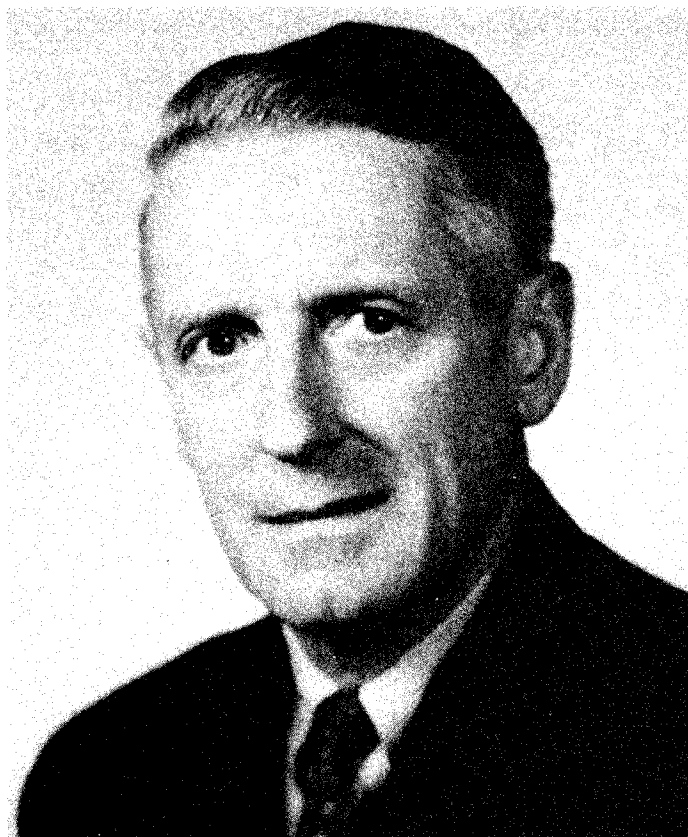
Letters should be mailed to the Editor of the *Notices*, American Mathematical Society, P. O. Box 6248, Providence, RI 02940, or sent by email to notices@math.ams.com, and will be acknowledged on receipt.

Deane Montgomery

1909–1992

Deane Montgomery was born on September 2, 1909, in Weaver, Minnesota. He received a B.A. from Hamline University in 1929, a M.S. in 1930 and a Ph.D. in 1933 from the University of Iowa.

After having held various fellowships at Harvard University, Princeton University, and the Institute for Advanced Study, he went to Smith College, where he was successively assistant professor (1935–1938), associate professor (1938–1941), and professor (1941–1946). During that period, he was also a Guggenheim fellow at the Institute and a visiting associate professor at Princeton University. After two years at Yale University as an associate professor (1946–1948), he came to the Institute, where he was a permanent member from 1948 to 1951 and a professor from 1951 to 1980, at which time he became emeritus.



His thesis adviser had been E. W. Chittenden, and he had a solid background in real analysis and point set topology. His initial research interests focused on the latter, to which he devoted his first four papers. In the tradition of L. E. J. Brouwer and “Polish topology”, they already show considerable technical strength and expertise. As soon as he came to Harvard and Princeton, he broadened his interests, first to algebraic or geometric topology (initially on his own and in a private study group including N. Steenrod and Garrett Birkhoff), and then gradually to transformation groups, which became his major interest for the rest of his career.

His first papers in that area, many written in collaboration with Leo Zippin, were in part in the spirit of earlier work of Brouwer and Kerejarkto, aiming at characterizing groups of familiar euclidean motions such as translations or rotations by topological conditions. They were motivated by questions on the foundations of geometry and, foremost, by Hilbert’s fifth problem. In the broad sense, the latter asks, given a locally euclidean topological group acting effectively (i.e., no element $\neq 1$ acts trivially) on an analytic manifold, whether coordinates can be introduced to make the group and the operation analytic (the answer is no). In its narrow sense, it asks whether a locally euclidean topological group is, after a suitable change of coordinates, a(n analytic) Lie group. Variants of the first problem and the second one became points of major interest in the next fifteen years or so, but not of sole interest, though.

Among Deane’s contributions to the first question, let me mention the following results pertaining to a (separable metric) locally compact group G acting effectively on a manifold M : (i) If G is compact, M analytic, and each transformation is analytic, then G is a Lie group (1945); (ii) (with S. Bochner, 1946). If M is C^2 and every transformation is C^2 , and no element $\neq 1$ leaves pointwise fixed a nonempty open subset, then G is a Lie group; (iii) (with S. Bochner, 1947). If M is a compact complex analytic manifold and G the group of automorphisms of M , then G is a complex Lie group acting holomorphically. On the fifth problem proper, after a series of papers with L. Zippin, Deane gave a positive solution in dimension three (1948). Then came shortly afterwards the decisive results proved jointly with L. Zippin: The existence of a closed subgroup isomorphic to $\mathbb{R}$ in a locally compact, noncompact, connected, separable metric group of strictly

positive finite dimension (1951) (also established by A. Gleason) and then the reduction to groups without small subgroups (1952). Since A. Gleason had just proved that such a group is a Lie group, that gave a positive answer to Hilbert's fifth problem. In fact, the whole investigation had been carried out for separable metric finite-dimensional locally compact groups and it was shown more generally that such a group is a "generalized Lie group", i.e., possesses an open subgroup that is a projective limit of Lie groups, hence is a Lie group if it is locally connected. The assumption of finite dimensionality was soon removed by H. Yamabe, who was Deane's assistant at the time.

This was the climax of a major effort and, as I remember it, some people were mildly curious to see where Deane would turn, now that this big problem had been solved. But he did not have to look around at all. Apart from writing with L. Zippin a systematic exposition of the work on the fifth problem (1955), he just went back full time to what was really his main interest (and is already the subject matter of the last chapter of that book): Lie groups (especially compact Lie groups) of transformations on manifolds, so that, in the context of his whole work, the contributions of the fifth problem appear almost as a digression, albeit a most important one.

Even during that hot pursuit, Lie transformation groups were very much on his mind, and he brought a number of interesting contributions, in particular in joint works with L. Zippin and with H. Samelson. In fact, two papers with H. Samelson on compact Lie groups transitive on spheres or tori (1943) have a special place in my memory: When I was an assistant in Zürich, H. Hopf once gave me copies of them, and I could generalize and sharpen some of their results. This led to my first single author paper, which I submitted for publication in the *Proceedings of the AMS* to Deane, then an editor; my first contact with him.

The general problem in transformation groups is, roughly, to relate the structures of the group G , the manifold M operated upon, the orbits, fixed points, and the quotient space. At the time, there was one body of special, but deep, work, that of P. A. Smith on homeomorphisms of prime power order of homology spheres or acyclic spaces. Very little was known otherwise, and Deane was a prime mover in the development of a general theory, which he pushed in many directions. He and various collaborators proved a number of foundational results, as well as more special ones, which often opened up fruitful directions for others. A survey of these contributions and of work they led to is given by F. Raymond and R. Schultz in the *Proceedings of a Conference honoring Deane on his 75th birthday (Contemporary Mathematics, vol. 36 (1983))*, and I shall not try to duplicate it. It ranges from basic results such as the existence of a slice (with C. T. Yang, 1957), a powerful tool to study a group action near an orbit, the existence of a principal type of orbits (with C. T. Yang, 1958), to more special ones, such as actions on euclidean space or spheres with orbits of small codimension or the existence of smooth actions of SO_3 on euclidean space without fixed points (with P. E. Conner, 1962). In a first phase, the emphasis was on continuity, i.e., on topological properties, but Deane

kept up with the great advances of differential topology and soon veered more and more to differentiable actions, adapting techniques and points of view of differential topology. This led to his last major effort, a long series of joint papers with C. T. Yang on free or semi-free (i.e., free outside the fixed point set) actions of the circle group on homotopy 7-spheres, which produced notably many interesting examples of homotopy complex projective 3-spaces (1966–1973).

During his tenure as a professor at the Institute, Deane was at the center of activity in topology (algebraic, geometric, differential), one of the highlights in the life of the School, first by his seminar, a perennial feature and a meeting ground for topologists in the Princeton community, but also in more informal ways. He frequently organized seminars in his office, usually with some younger members with whom he would go through some recent developments. He was always seeking out and encouraging young mathematicians. He and his wife Kay would regularly and very warmly receive the visiting members at their home. Maybe remembering his own beginnings in an out of the way place, he had a special interest, and talent, in finding out people with considerable potential among some applicants from rather isolated places about whom not much information was available.

His concern for the Institute went far beyond his immediate scientific interests and was all encompassing. He had a very high view of the role the Institute should play and served this ideal with unwavering and thoroughly unselfish loyalty. In day to day contacts, he was very kind, informal, full of understanding, always ready to help, and struck one as a very mild person, but deceptively so for anyone who, in his eyes, would threaten the Institute's standards, and who would then soon see rising an iron-willed and formidable opponent. His care for the highest standards at the Institute, later gratefully acknowledged in citations by the Trustees, was not always universally understood or shared at the time, so that he and like-minded colleagues had to weather some rather stormy moments, during which he was totally unshakable.

His abiding interest in the welfare of mathematics also led him to accept a number of official positions. In particular, he was Vice President (1952–1953), elected Trustee (1955–1961) and President (1960–1963, includes terms as President-Elect and Ex-President) of the AMS, where he also served on a number of committees, and President of the International Mathematical Union (1974–1978).

Honors, too, came his way: Honorary Doctor of Science from Hamline University (1954), Yeshiva University (1961), the University of Illinois (1977), and the University of Michigan (1986), as well as a Doctor of Laws degree from Tulane University (1967); election to the National Academy of Sciences in 1955, to the American Academy of Arts and Sciences, and the American Philosophical Society in 1958; and receipt of the Steele Prize of the AMS in 1988.

Deane was an early riser and it was a rare event for anyone to be at the Institute before him. Being very gregarious, he talked to practically everybody working in any capacity at the Institute, which won him the respect and affection of members and staff alike and gave him an exhaustive knowledge of the

Institute. Through O. Veblen, to whom he had been very close during the latter's late years, it reached to the very beginnings of the Institute so that he was a walking encyclopedia on all aspects of the Institute's history and operations.

In 1988, he and Kay moved to Chapel Hill, NC to be close to their daughter and granddaughters. That prospect did not fully compensate for the severance of the ties with an institution which had meant and still meant so much to him, and it was altogether a rather sad occasion, the sadness of which was hardly mitigated by promises to keep in touch. Being myself a fairly early riser, I often started my day by

knocking at his door, sure to find him, to have a chat, mostly about mathematics, mathematicians, and Institute affairs. That I have not been able to do so after his departure has left for me a void which could not be filled.

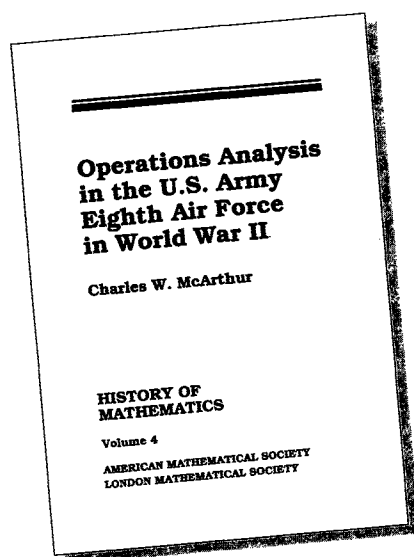
Deane died in his sleep in Chapel Hill, on March 15, 1992. He is survived by his wife, his daughter Mary Heck, and two granddaughters.

Armand Borel
Institute for Advanced Study

"This fascinating book is not of math, but of men."

Operations Analysis in the United States Army Eighth Air Force in World War II

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—Jerome Stern,
Tallahassee Democrat

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1991 *Mathematics Subject Classification*: 01
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The AMS fSU AID FUND

Your Contribution Now Counts Twice!

To help sustain the mathematical sciences in the former Soviet Union (fSU), the Sloan Foundation has awarded the AMS a \$30,000 challenge grant to support the **AMS fSU AID FUND**. Contributions to the fund will now be matched on a dollar-for-dollar basis.

The **AMS fSU AID FUND** will support a four-point program:

- Providing small grants to students, young mathematicians, and established scholars.
- Supporting development of the Moscow Mathematics Institute.
- Sending mathematical literature to libraries in the fSU.
- Supporting independent group efforts in the fSU and other special needs, such as workshops, conferences, and exchanges.

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fSU



**American
Mathematical
Society**

Sloan Foundation Joins AMS to Aid Mathematics in the Former Soviet Union

As reported in the July/August 1992 issue of the *Notices* (pages 557–558), the Society has launched the AMS fSU Aid Fund to provide assistance to the mathematical sciences community of the former Soviet Union. Because of political and economic crises in the former Soviet Union and Eastern Europe, the distinctive traditions and future promise of this prolific community could all but disappear without international assistance. There have been a number of developments since the appearance of the previous *Notices* article.

The Sloan Foundation has awarded the AMS a “challenge grant”, which will match individual contributions to the Fund up to a total of \$30,000, to support the small grants component of the assistance program. Since the appearance of the call for contributions in the July/August *Notices*, the Society has already received a number of contributions. If the fundraising effort goes well, the Sloan Foundation has indicated it will consider making a second challenge grant. The American Physical Society, for example, has received a \$100,000 challenge grant from Sloan.

In addition, the Advisory Committee for the program has now been appointed. The members of the Committee are: Michael Artin, AMS President, Massachusetts Institute of Technology; William H. Jaco, AMS Executive Director; Robert D. MacPherson, MIT; Cathleen Morawetz, Courant Institute of Mathematical Sciences; Robert O’Malley, President of the Society for Industrial and Applied Mathematics, University of Washington; John C. Polking, AMS Trustee, Rice University; Linda Preiss Rothschild, University of California at San Diego; and Daniel Stroock, MIT. The Committee will also benefit from the advice of a group of consultants in the former Soviet Union and elsewhere.

Some aspects of the program have evolved since the previous *Notices* article. The four primary activities, described below, will comprise all areas of the mathematical sciences, including applied areas, statistics, and probability.

- *Small Grants.* These grants will be made directly to individuals, with a focus on graduate students, young mathematicians, and established scholars. Recommendations for grantees will be made by a panel of mathematical scientists in the former Soviet Union. The Sloan Foundation funds will support this activity.

- *Moscow Mathematics Institute.* Directed by Askold Khovanski and established in 1991, the Moscow Mathematics

Institute is a gathering place for researchers and students in the mathematical sciences. On the governing board are Pierre Deligne of the Institute for Advanced Study, Vladimir Drinfeld of the Institute of Low-Temperature Physics in Kharkov, Ukraine, and Alexander Beilinson and Robert MacPherson of the Massachusetts Institute of Technology. Its staff will be comprised of a few permanent members, some three-year appointees, and visitors from abroad. The AMS fSU Aid Fund will help support this important institute.

- *Libraries.* An AMS Reading Room, with copies of AMS books and journals and MathSci in CD-ROM, is the centerpiece of this effort. In addition, the AMS plans to identify libraries in the former Soviet Union to receive free subscriptions to Society journals.

- *Independent groups and other needs.* Plans are also being made to support a variety of independent group efforts that have arisen in a number of locations to support and revitalize mathematical sciences research and scholarship. One notable example is the Mathematics Department at the Independent University of Moscow, headed by V. I. Arnold. Other efforts are under way in St. Petersburg, Novosibirsk, Kharkov, Kiev, and other cities. In addition, the AMS is looking into other needs, such as workshops, conferences, and exchanges.

At present, the political and economic climate of the former Soviet Union is quite uncertain. The AMS and the Advisory Committee are monitoring the situation and will make every effort to obtain reliable information from a variety of sources inside and outside the former Soviet Union to insure that the AMS fSU Aid Fund is put to the best possible use. The goal is to provide short-term support to bring a measure of stability to the mathematical sciences community and sustain its intellectual activity during these difficult times.

The AMS calls upon the international mathematical sciences community to contribute toward this important effort to help keep alive mathematical sciences research and scholarship in the former Soviet Union. Please see the accompanying advertisement on the previous page for information on how to make a contribution. Questions about the AMS fSU Aid Fund may be directed to Timothy J. Goggins, AMS Development Officer, 401-455-4110; electronic mail tjg@math.ams.com.

Allyn Jackson
Staff Writer

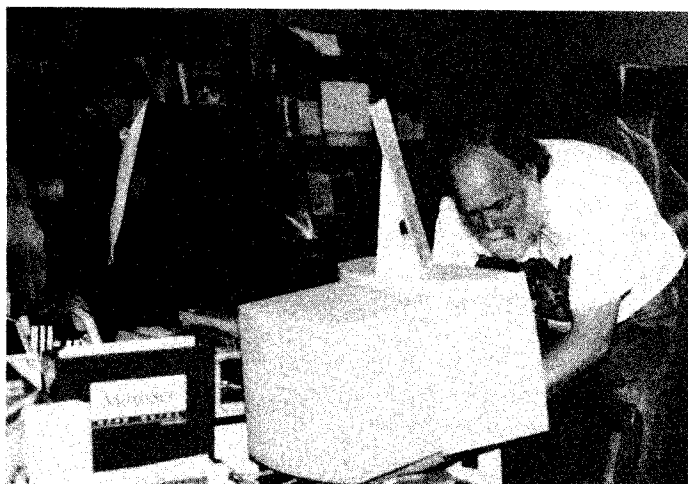
European Meetings Bring Mathematicians Together

Historic "Firsts" in Cambridge and Paris

This summer, two back-to-back meetings in Cambridge and Paris brought the U.S., Europe, and the former Soviet Union a little closer together. The joint meeting with the London Mathematical Society (LMS), held June 29 to July 2 in Cambridge, England, marked the first AMS international meeting, and its first joint meeting with the LMS. The following week, the first European Congress of Mathematics brought together mathematicians from all over Europe and the former Soviet Union to participate in a wide-ranging program. In between these two events was the inaugural opening of the Isaac Newton Institute, headed by Sir Michael Atiyah of Trinity College, Cambridge University.

The AMS-LMS Meeting

The Joint AMS-LMS Meeting began on a warm Monday evening, when John M. Ball of Heriot-Watt University presented an intriguing talk about the mathematics of microstructure—an unusual physical phenomenon in that certain energy functions associated with microstructure do not attain a minimum. The plenary lectures were, on the whole, expository and accessible to a general mathematical audience. Spanning a range of areas, the list of speakers included Lawrence Craig Evans of the University of California at Berkeley, Benedict Gross of Harvard University, Nigel Hitchin of the University of Warwick, and Edward Witten of the Institute for Advanced Study.



The book exhibit at the AMS-LMS meeting.

"We were very fortunate to get together such a strong group of speakers from both sides of the Atlantic," commented Sir John Kingman, President of the London Mathematical Society. "This was partly due to the attraction of Cambridge, but also due to the fact that the program committee had put together a very interesting program." One participant remarked that this was a very good "working meeting", unlike many general conferences of this type.

"The impressions I got from talking to quite a few of the participants at the AMS-LMS meeting were very positive," noted Ronald Graham, AMS President-Elect. "They were very happy with the number and quality of the talks and with the substantial attendance. In fact, many people thought that it would have been better to spread the meeting over three days because it was packed pretty tightly in the two days scheduled." (Despite the intensity of the schedule, some participants managed to find spare time to punt on the River Cam or quaff beer on the bridges arching over the river.)



Paul Halmos at a reception during the AMS-LMS meeting.

A total of 477 people registered, with 162 from the United Kingdom, 220 from the U.S., and 95 from other countries. Ten publishers hawked their wares, some of them in rather steamy conditions in the Mill Lane Lecture building, which, like most buildings in Cambridge, had no air conditioning. Despite the humidity, the hospitality of the LMS was evident through the

efforts of staff members Susan Oakes and Harvinder Lotay, who, together with AMS housing and registration coordinator Penny Pina, made sure everything ran smoothly.

The social activities of the conference were particularly well attended and jovial. A reception held the first evening of the meeting attracted a crowd of more than five hundred and included a sculpture exhibit of the work of Gabriella Bollobás. The most commanding piece was a full-size sculpture of Newton and Dirac talking together (at one point, someone had placed an apple in Newton's outstretched palm). The following evening, nearly 300 people attended the conference dinner, the highlights of which were the excellence of the food and service and an eloquent speech by Sir John.



Sir John Kingman (left), President of the LMS, and Ronald Graham, President-Elect of the AMS.

This was a historic venture for the AMS and LMS, in more ways than one. "I think it got the staffs of the two societies to get to know one another better and to work together," commented Sir John. "We've always had a close relationship, but at distance, in the sense that we've talked on the telephone and written, but not worked together face to face." In addition, it was an important event for the British mathematical community, which does not often host meetings of this size. "The significant thing was to get so many North American mathematicians visiting at one time," said Sir John. "Often we have visitors from the U.S. and Canada, but not as a group at one time, and this was an event we welcomed."

The Isaac Newton Institute

During the AMS-LMS meeting, workers were rushing to put the finishing touches on the Isaac Newton Institute—rolling out stretches of lawn, polishing the bannisters, arranging the furniture, and hanging a portrait of Sir Isaac Newton. For a visitor arriving on Tuesday June 30, it was a little difficult to believe that everything would be ready for the inaugural opening the following Friday. But Friday came, and everything was in readiness for the opening events.

Light, airy, and elegant without being formal, the Institute building was designed with mathematics in mind. Thirty offices on the second and third levels circle a central open area

that brings in light and encourages discussion and interaction. Architect Duncan Annand explains that one can see from anywhere in the building what's going on in the common areas. There is a library and two seminar rooms, one of which holds about 120 people. "We wanted space where people could interact, so [Annand] came up with this design, and then we commented on it," notes Sir Michael. "We're very pleased with it, it worked out exceptionally well... 'Architects are more often interested in what the outside looks like, they're not too worried about the inside, whereas people are using the inside, that's what's important. So we're very pleased here, he's put a lot of thought into it.'" Annand came to understand at least a few things about what mathematicians are like: there are chalkboards *everywhere*, even in the bathrooms—even in the elevator.



The Isaac Newton Institute

The Newton Institute does not have a permanent staff, except for Sir Michael, Deputy Director Peter Goddard, a theoretical physicist at Cambridge, and the administrative staff. Rather, the Institute will bring in a rotating staff of visitors. The scientific aim of the Institute is to cover a broad area of mathematics and its connections with other areas of science. "We're going to definitely have a lot of things which spread over from mathematics into all sorts of other disciplines—biology, economics, physics, computer science," says Sir Michael. "I think the view is at the present time that a lot of the future development of mathematics probably will be to use more advanced mathematics in related fields and to bring problems from other fields into mathematics. So our aim is really to bridge the gap by bringing people together." In addition, while the Institute is intended to be an international center for research, "we hope it will have a major impact on British mathematics. Cambridge is obviously a good center from that point of view, there's a lot of mathematics here already... And I think we were very fortunate that we were able to time it so that we could start off just at the time of [the AMS-LMS] joint meeting".

Every six months, the Newton Institute will run two concurrent programs in different areas. From July to December 1992, there are programs on low-dimensional topology and

quantum field theory and on dynamo theory, and from January to June 1993, the focus will be on L -functions and arithmetic and on epidemic models. Next year, there will be programs in computer vision; random spatial processes; cellular automata, aggregation, and growth; and geometry and gravity.



One of the common areas at the Newton Institute.

Sir Michael says the Institute will consider nearly any scientific area for a program, provided there is some serious mathematics involved. "Also, it ought to be an area which is going through an exciting stage . . . And it probably ought to be one which brings people together from different backgrounds, different disciplines, or makes a new contribution. So, we don't go in for orthodox, conventional type meetings, of which there are plenty already. We'll try to do something new."

St. John's College, Cambridge constructed the new building and also provided £750,000 to cover most of the first five years' rent. In addition, Trinity College, Cambridge has established the Newton Trust, which is providing £1 million for other expenses during that period, and other Cambridge colleges have given grants. There are also many donors from outside Cambridge, including the London Mathematical Society, and from outside the U.K. In addition, the Science and Engineering Research Council of the U.K. has awarded the Institute over £1.5 million over the coming four years. Presently, the total funding for the Institute stands at over £5 million. Sun Microsystems and Apple U.K. donated workstations for computing, word-processing, and email.

The inaugural activities for the Newton Institute included talks on pure and applied topics reflecting the diversity of topics in the coming two years of activities. Vaughan Jones of the University of California at Berkeley presented a lucid and entertaining lecture on knots that would have been understandable to a high school student. At one point, Jones broke the "No Smoking" rule of the Institute and lit a cigar to demonstrate the origins of knot theory. "This, believe it or not, is what happened," said Jones: In the 1860s, Lord Kelvin became interested in the idea of knotted vortices when Tait blew some smoke rings during a lecture in Edinburgh. Jones says he's been trying for years to blow a trefoil smoke ring, but without success. After surveying some

of the main results in the development of knot invariants, Jones wound up the lecture by touching on some of the recent connections between knot theory and statistical mechanics, quantum field theory, and von Neumann algebras. The other speakers included Sir Peter Swinnerton-Dyer, Senior Fellow at the Newton Institute, who spoke on arithmetic; Keith Moffatt, Cambridge University, who spoke on flow; Roy Anderson, Imperial College, a biologist who discussed epidemics; and Allan Chapman, Oxford University, who presented a historical perspective on Newton and his work. Sir Michael closed the day's activities with a short talk about the Newton Institute.

Given his responsibilities as President of the Royal Society of London and Master of Trinity College, Sir Michael says he can devote only limited time to the Newton Institute. He acknowledges the efforts of Deputy Director Goddard, who has been involved in the Institute from the early planning stages right through the construction of the building and the appointment of staff. "Goddard is the person who really worked enormously long hours to get things going," says Sir Michael. "I have limited time, so I just help and advise on policy, the scientific mission, things like that . . . I hope I have some time to come in. I won't really work here; I have offices elsewhere." But maybe he'll come in to do a little mathematics? "Absolutely. . ."

The European Congress of Mathematics

Following on the heels of the AMS-LMS meeting and the opening of the Newton Institute was yet another historic event: the first European Congress of Mathematics (ECM), held in Paris, July 7–11. Centered at the Sorbonne University in the lively Latin Quarter, the ECM combined French sensibility for the good life with an ambitious vision for the Congress, which included some serious and successful efforts to go beyond the usual presentation of mathematical lectures and reach out to a broader audience of nonmathematicians and young people.

Credit for the idea of a European Congress generally goes to Max Karoubi of the University of Paris V who was named Founder of the Congress. Together with the efforts of Rudolph Rentschler at the University of Paris VI, who joined Karoubi early on in the project, Karoubi began working on preparations for the ECM in mid-1989 and was able to secure funding for the ECM from European Community sources in Brussels and the French government. As the project proceeded, the Société Mathématique de France and the Société des Mathématiques Appliquées et Industrielles agreed to sponsor the Congress, and various committees were appointed to bring the idea to fruition. Among the key players were Fulbert Mignot of Paris VI and Paris XI, chair of the Organizing Committee, and François Murat of Paris VI, who served as treasurer; Hans Föllmer of the University of Bonn, chair of the Scientific Committee; and Henri Cartan, member of the Académie des Sciences de Paris and professor emeritus at the University of Paris XI (Orsay), chair of the Steering Committee. Together with the organizers of the Round Tables, there were nearly one hundred people involved in planning and executing the ECM.



The chapel of the Sorbonne

The Congress attracted the attention of the media and resulted in a number of newspaper articles on mathematics in French papers and magazines, as well as periodicals in other countries. The high level of interest the Congress drew was also evident in the speech by Hubert Curien, the French Research Minister, at the Opening Ceremonies. Also presenting a speech was Friedrich Hirzebruch, director of the Max Planck Institute and president of the European Mathematical Society (EMS). Founded in Poland in October 1990, the EMS is intended to serve as an advocate for mathematics on issues that reach beyond national borders. More than thirty mathematical societies belong to EMS, and there are also about 1100 individual members, who have the option of joining through their local mathematical societies.

One of the concerns that prompted the formation of the EMS was the situation for mathematicians in Eastern Europe and the former Soviet Union. Although travel restrictions have eased considerably in recent years, economic problems make travel to conferences effectively impossible for many mathematicians. Moreover, many have had problems obtaining visas to visit other countries. For this reason, the Congress organizers raised funds specifically to cover the living expenses and registration fees for needy participants from the former Soviet Union and Eastern Europe. Although some still could not attend because getting to Paris was prohibitively expensive, the ECM was quite successful in bringing a large contingent from that region: out of a total of 1300 participants, there were about forty registered participants from Russia (the same number as from the U.S.), another forty or so from other states in the former Soviet Union, and nearly two hundred from other countries in Eastern Europe.

Several lavish social events heightened the celebratory spirit of the Congress. The opening reception at the Palais de la Decouverte, a science museum, attracted a substantial fraction of the Congress participants, who feasted on hors d'oeuvres, petit fours, and champagne. On another evening,

the various embassies in Paris invited participants from their countries to receptions. One of the largest, with over 200 people, was given by the German Embassy, where, on the occasion of his 88th birthday, Cartan was presented with a bouquet of flowers by the German ambassador. In addition to his mathematical distinctions and his work on the ECM, Cartan has been politically active in advocating for a united Europe.

Perhaps the most important reception, though, was held at the Hotel de Ville, where Jacques Chirac, Mayor of Paris and former Prime Minister of France, presented prizes sponsored by the city of Paris on the occasion of the ECM. The prizes were awarded to ten mathematicians under the age of thirty-two: Richard Borcherds, Jens Franke, Alexander Goncharov, Maxim Kontsevich, François Labourie, Tomasz Luczak, Stefan Müller, Vladimir Sverak, Gabor Tardos, and Claire Voisin. Kontsevich and Borcherds presented parallel session talks during the ECM. In addition, the prize committee paid an eloquent tribute to Andreas Floer, who died last year under tragic circumstances at the age of thirty-four.

The plenary speakers at the ECM spanned a wide range of areas and perspectives. One participant commented that the Scientific Committee must have impressed upon the speakers the need to make their talks accessible to a general mathematical audience, because most were expository with a good balance of technical details. In particular, the lecture by László Babai of the University of Chicago and Loránd Eötvös University about recent work on transparent proofs seemed to be a favorite among the participants, as it touched on the foundations of mathematics and what is meant by the notion of “proof”. David Mumford of Harvard University presented a fascinating survey lecture about the tough mathematical problems posed by computer vision. V. I. Arnold of the Steklov Mathematical Institute was the final speaker on the program, and his lecture on Vassiliev’s knot invariants demonstrated that mathematical research continues to flourish in the former Soviet Union. Two days of the Congress were devoted to parallel sessions that comprised forty lectures, and these featured some of the top mathematicians in Europe. In addition, there were about fifteen more specialized “satellite” conferences that took place before and after the ECM that drew many participants.

Perhaps the most unusual aspect of the ECM, and probably the most difficult to pull off, were the sixteen Round Tables that examined the relations between mathematics and society and connections between mathematics and other areas of science. Given the complexity of the problems they addressed, and the fact that their inclusion in such a conference has almost no precedent, they can be counted as a success. One of the liveliest discussions took place at the Women and Mathematics Round Table, organized by Eva Bayer of Centre National des Recherches Scientifiques, Besançon. The panel, which included women mathematicians from Italy, Germany, Poland, the U.S., and France, brought out some differences among various countries’ representation of women in mathematics. For example, figures presented at the session show that women currently comprise about 35% of the

mathematicians in Italy while in 1987 there were only 3% women among mathematicians in West Germany.



I. M. Gelfand (left) and V. I. Arnold. Photo courtesy of Leon Betute.

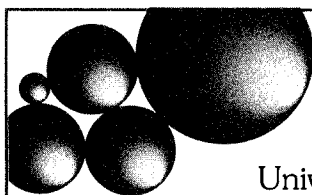
At the Round Table on Mathematics and the General Public, Alexei Sossinsky of Moscow described some of the programs that mathematicians in the former Soviet Union have developed to cultivate an interest in mathematics among young people. As the former editor of *Kvant*, a mathematics and science magazine for young people, Sossinsky has had extensive experience in this area. He described problem-solving seminars, popular mathematics books, olympiads, summer schools, Gelfand's mathematics correspondence school, and other efforts that have contributed to the distinctive Russian tradition of inspiring mathematical interest in young people.

Many have said that Russian mathematics could all but disappear in ten to fifteen years; Sossinsky stated that the only source of optimism is these kinds of educational programs, though even their fate is uncertain at this time. (Please see the article on p. 688 in this issue for information on the AMS program to assist mathematics in the former Soviet Union.)

There were other unusual features of the Congress that made it clear that mathematics doesn't just consist of a bunch of experts sitting and talking only to each other. One example was the "Junior Congress", a three-day event for high school students that kicked off on the second day of the ECM with an afternoon and evening program for high school students featuring talks by mathematicians and by the students themselves. There was also an exhibit called Horizons Mathématiques, which was open to the public and which illustrated various mathematical concepts through manipulatives, puzzles, drawings, soap bubbles, and so on. In addition, David Singmaster of South Bank University in London assembled an extensive exhibit of puzzles containing mathematical content, and there was a program of mathematical films and videotapes shown on three afternoons, as well as a number of musical presentations.

The plan is to hold a European Congress every four years, between the International Congresses. The next ECM, scheduled for Budapest in 1996, will have a tough act to follow to surpass the lively and varied events and the high scientific quality of the Paris conference. But most likely the Budapest Congress will have a flavor all its own, so *Vive la différence*.

Allyn Jackson
Staff Writer



Why the Boundary of a Round Drop Becomes a Curve of Order Four

University Lecture Series, Volume 3 • A. N. Varchenko and P. I. Etingof

This monograph concerns the problem of evolution of a round oil spot surrounded by water when oil is extracted from a well inside the spot. Varchenko and Etingof discuss this topic and other recent work in the theory of fluid flows with a moving boundary. Problems are included at the end of each chapter, and there is a list of open questions at the end of the book.

Contents

Mathematical model; First integrals of boundary motion; Algebraic solutions; Contraction of a gas bubble; Evolution of a multiply connected domain; Evolution with topological transformations; Contraction problem on surfaces.

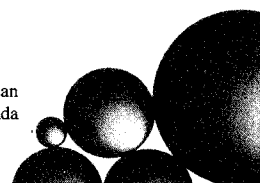
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The Forum section publishes short articles on issues that are of interest to the mathematical community. Articles should be between 1000 and 2500 words long. Readers are invited to submit articles for possible inclusion in Forum to:

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NSF Graduate Fellowship Program

NSF Graduate Fellowship Panel

Sylvia Wiegand, Chair

We have just served on the panel that awards National Science Foundation (NSF) Graduate Fellowships in mathematics. Part of the purpose of this letter is to explain the selection process to the mathematics community, especially to potential applicants, advisors, and writers of letters of recommendation.

I. The mathematics panel reviewed 257 applications for twenty-six awards. The number of awards in a given discipline is roughly proportional to the number of competitive applications in that discipline. In other words, to a certain extent, we would have more awards in mathematics if more students applied. Physics and chemistry each had almost twice as many applications as mathematics, with a correspondingly greater number of awards; there were 7,723 applications in all fields.

II. In view of the large number of highly qualified candidates and the small number of fellowships, the award of "honorable mention" should be viewed as a competitive recognition of significant achievement.

As an illustration of the quality of the applicants for mathematics, fifteen percent had perfect GRE subject test scores and three and a half percent (nine) had perfect scores on all four parts of the GRE. (Scores on these exams are just one consideration; letters of recommendation, grades, and individual student statements are also very important.)

III. Carefully written and appropriate *letters of recommendation* are extremely helpful in the evaluation process. In particular, comparisons between two or more applicants make the panel's job easier, and comparisons to successful

mathematicians at a similar stage of development are especially influential. Students should be advised that letters from scientists other than mathematicians tend to carry less weight and letters from nonscientists carry virtually no weight at all.

IV. The mathematics panel found *research experience* desirable but did not consider it essential to a successful application. Many of the applicants have been through one of the *Research Experiences for Undergraduates* programs sponsored by the NSF; several have even published papers.

The panelists viewed rambling and unfocused statements (under career goals, research experience) as detrimental. It is best to be concise and to the point. Panelists must review many applications in a short time, and information buried in long-winded statements will most likely be overlooked. Applicants should play to their strengths; all relevant experiences should be mentioned.

V. First-year graduate students may apply, as well as senior undergraduates. There are fewer of the former than might be expected—just sixty-four this year, and seven of them received awards. Possibly the graduate students have difficulty finding letter writers at their new institutions. It may be that the fellowships should be better advertised to this group; faculty should be encouraged to bring the fellowships to the attention of their advisees/students.

VI. In its announcement of the competition, the NSF encourages applications from members of minority groups, women, and persons with disabilities, although the panelists are expected to disregard race, sex, and handicap in their deliberations. There is a separate program for minority fellowships. (Many students compete in both.) There is a separate program for women in engineering. There is also additional financing for persons with handicaps who are successful (defined to include honorable mention) in the initial competition.

However, there is no special program for outstanding women in mathematics. The panel wondered if such a program might be initiated for women in mathematics, because (1) there are still various barriers that put women at a disadvantage in this competition and (2) we feel that additional incentives for women would inspire more women to pursue mathematics.

The panel has noticed that women may not do as well in our evaluation process due to a number of factors: perhaps they have had a harder time finding mentors for research projects; women often score lower than men on tests (although they

may have better grades than men); and references may be written with a bias towards men. The panelists are sensitive to these problems, but have not felt that women's applications should be evaluated differently from men's. The panelists would like to see extra fellowships set aside specifically for women. We need more highly qualified women graduate students, more women writing excellent Ph.D. theses, and more women with outstanding careers in mathematics.

There were fewer female applicants this year (eighty-three) than last year (ninety), although overall the number of applicants went up (257 applicants this year versus 222 last year). This year only three fellowships were awarded to women in mathematics; last year ten were awarded to women. (Last year there were thirty-two awards in all, whereas this year there were only twenty-six.) The picture in computer science and in applied mathematics is equally bleak—last year five fellowships went to women in computer science, this year, two; last year four went to women in applied mathematics, this year, three.

Note: If mathematicians and others are interested in an extra program for women, they should write to Dr. Terry Porter, Division Director for Research Career Development, and to the Division Director for Mathematical Sciences. (Presently that director is Dr. Judith Sunley; for the next few

months it will be M. Kent Wilson on an acting basis; after that, another individual will be named to the position.)

VII. The panelists present the NSF with three unordered, alphabetized lists. All the applicants in the first list and half the applicants in the second receive awards. The awardees in the second group are chosen by the National Science Foundation, based on geographical and other considerations. This year the first two lists comprised six and eight percent of the applicants respectively. The third list is for those who will receive honorable mention along with those in group two who don't get awards.

VIII. In giving these details, we are concerned that mathematics faculties should not discourage good mathematics students from applying for an NSF Graduate Fellowship. We submit that it is beneficial for our profession and for students to go through the process of applying, even if the application does not result in an award. We hope faculty will explicitly encourage students who are considering graduate school to apply. This would yield: an early opportunity to think about graduate school; an early opportunity to refine thinking about what one wants to accomplish in graduate school; and experience in writing about oneself and one's goals with respect to mathematics.



Translations of Mathematical Monographs

Multidimensional Residues and Their Applications

A. K. Tsikh

Volume 103

Tsikh's book presents a systematic account of residues associated with holomorphic mappings and indicates many applications. The book begins with preliminaries from the theory of analytic sets, together with material from algebraic topology that is necessary for the integration of differential forms over chains. Tsikh then presents a detailed study of residues associated with mappings that preserve dimension (local residues). There is also a treatment of residues associated with mappings that reduce dimension—that is, residues of semimeromorphic forms, connected with integration over tubes around nondiscrete analytic sets.

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Computers and Mathematics

Edited by Keith Devlin

This month's column

Primality testing and related computational pastimes frequently put mathematics onto the pages of the national press. I suspect that the general impression created in the public mind by such publicity is that computers will, one day soon, put most mathematicians out of a job. Of course, the reality is—as it is in almost all areas where the computer has had a significant impact—that the computer revolution has certainly changed the nature of what many mathematicians do, and the way they do it, but, if anything, has created more need for mathematicians, not decreased it. I myself fall into the camp of those who think that almost any publicity is good publicity, and pure mathematicians need publicity just as much as any other group, and perhaps more so given our almost invisible profile until recently. But I know that there are many who disagree with this view.

Still, I think we probably all agree that, publicity or not, computational investigations, even in areas of mathematics that are of the “recreational” variety that appeal to journalists, can lead to interesting, nontrivial, and worthwhile mathematical results. Such is the case with Carmichael numbers. Earlier this year, Red Alford, Andrew Granville, and Carl Pomerance of the University of Georgia proved that the set of Carmichael numbers is infinite, thereby solving a problem that has been around for some 80 years or so.

Their joint paper *There are infinitely many Carmichael numbers* presently exists only in preprint form, but I asked Granville to write an expository article on the work for this column. The result constitutes this month's lead article.

Following on from Granville's piece, Barry Simon presents the results of a series of benchmark tests he has run on a number of computer mathematics systems. The format is much the same as in Simon's previous benchmark evaluation, which he reported in this column in September 1990 (*Notices*, Volume 37, Number 7, pp. 861–868).

Finally, if any readers are interested in reviewing software for this column, please let me know. The information I need is the equipment at your disposal and the kinds of software you would be interested in reviewing. I currently have more volunteers than I need for trying out NeXT software, but need more people prepared to review software for Macs or PCs.

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Primality Testing and Carmichael Numbers

Andrew Granville*

The problem of distinguishing prime numbers from composite numbers is one of the most fundamental and important in arithmetic. It has remained as a central question in our subject from ancient times to this day¹, and yet still fascinates and frustrates us all. From the very definition of primality, that an integer

n is prime if it has no divisor between 2 and $\sqrt{n}$, one can evolve a simple test for primality: Just check whether any integer d between 2 and $\sqrt{n}$ actually divides n . This is an easily implemented test for, say, $n = 107$ or $n = 11035$, but how about for $n = 123456789012345677$? This requires over a billion test divides, and if one were to try to verify that a given 100 digit integer n is prime in this way it would take longer than the remaining lifespan of our universe, even on an impossibly fast computer!

One thus needs a more sophisticated approach to handle large numbers. Perhaps a different definition of prime numbers will furnish us with a quicker method? One such definition follows from Wilson's Theorem (1770):

n is prime if and only if n divides $(n - 1)! + 1$.

So, to find out whether n is prime, we multiply together all integers less than n , add 1, and see whether the resulting number is divisible by n . However, this requires multiplying $n - 3$ pairs of numbers together, as opposed to $\sqrt{n}$ test divides earlier, so it takes even longer than our previous method.

The ancient Chinese made the startling discovery that

If n is prime then n divides $2^n - 2$,

which implies that

(1) If n does not divide $2^n - 2$ then n is composite (that is, not prime).

So we now have a new, and quite different, criterion, which will tell us that certain numbers n are composite. However, if

¹from Article 329 of Gauss's *Disquisitiones Arithmeticae* (1801)

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a number fails this criterion (that is, if n does divide $2^n - 2$), then it doesn't, *a priori*, tell us that n is prime; but let's check it out:

2 divides $2^2 - 2 = 2$	101 divides $2^{101} - 2$
3 divides $2^3 - 2 = 6$	103 divides $2^{103} - 2$
4 doesn't divide $2^4 - 2 = 14$	105 doesn't divide $2^{105} - 2$
5 divides $2^5 - 2 = 30$	107 divides $2^{107} - 2$
6 doesn't divide $2^6 - 2 = 62$	109 divides $2^{109} - 2$
7 divides $2^7 - 2 = 126$	111 doesn't divide $2^{111} - 2$
8 doesn't divide $2^8 - 2 = 254$	etc.
9 doesn't divide $2^9 - 2 = 510$	

In all of these examples we observe that n is prime exactly when n divides $2^n - 2$, and is composite otherwise. According to E. T. Bell, the ancient Chinese thought that this is always true², as did Leibniz many centuries later. However, the (smallest such) example, $n = 341$, refutes this belief since $341 = 11 \times 31$ is composite, yet 341 divides $2^{341} - 2$.

Further computation shows that such composite n seem to be rare and so we define a composite number n to be a **base 2 pseudoprime** if n divides $2^n - 2$. To exhibit quite how rare these are, note that up to 10^{10} there are around 450 million primes, but only about fifteen thousand such base 2 pseudoprimes, while up to 2.5×10^{10} there are over a billion primes, and yet fewer than 22 thousand base 2 pseudoprimes. So, if you were to choose a random number $n < 2.5 \times 10^{10}$ for which n divides $2^n - 2$ then there would be a less than one-in-fifty-thousand chance that your number would be composite.

Testing whether $2^{n-1} \equiv 1 \pmod n$ is easily implemented on a computer, as follows:

- (i) Write $n - 1$ in base 2, say $n - 1 = 2^{a_k} + 2^{a_{k-1}} + \dots + 2^{a_1}$ where $a_k > a_{k-1} > \dots > a_1$
- (ii) Compute $r_j \equiv 2^{2^j} \pmod n$ for $0 \leq j \leq a_k$, by taking $r_0 = 2$ and $r_{j+1} \equiv r_j^2 \pmod n$ for each $j \geq 0$
- (iii) Finally, since $2^{n-1} = 2^{2^{a_k}} \cdot 2^{2^{a_{k-1}}} \dots 2^{2^{a_1}}$, we have $2^{n-1} \equiv r_{a_k} r_{a_{k-1}} \dots r_{a_1} \pmod n$.

This algorithm requires no more than $20 \log^3 n$ operations so that, for a 40 digit number n , this "pseudoprime test" takes a few million operations (a few seconds on a PC) whereas test division takes more than a billion billion operations (over a thousand years on a PC). It has been suggested that one might obtain a practical primality test by writing down a list of all base 2 pseudoprimes, and then, if n divides $2^n - 2$ but is not on the list, one knows that n is a prime. Since there are less than 22 thousand base 2 pseudoprimes up to 2.5×10^{10} , this method works well in this range, and will continue to work well as long as the base 2 pseudoprimes remain so scarce. However, this won't always be so since Malo proved, in 1903, that there are infinitely many odd composite base 2 pseudoprimes by showing that if $n = ab$ (with $a, b > 1$) is

²However, it is now believed that Bell had no evidence of this, but was embellishing a good story. Just as standards of mathematical rigor have greatly improved over the last hundred years, so too the standards of rigor of mathematical history.

such a number, then so is $n' = 2^n - 1$.³ This is proved by observing that, since a divides n which divides $n' - 1$, thus $x^a - 1$ divides $x^n - 1$, which divides $x(x^{n'-1} - 1) = x^{n'} - x$, and so, in particular with $x = 2$, we get that $2^a - 1$ divides $2^{n'} - 1 = n'$ which divides $2^{n'} - 2$.

Our hope of obtaining a complete list of base 2 pseudoprimes is thus doomed, but we might still find all base 2 pseudoprimes up to some large number x . However, in 1982, Pomerance showed that there are more than $e^{(\log x)^c}$ base 2 pseudoprimes $\leq x$, for some constant c , $0 < c < 1$, once x is sufficiently large.⁴ This is quite a fast-growing function of x and shows that our hoped for, easy and quick primality test would not be practical for large values of x . So what else can we do?

On October 18th, 1640 Fermat wrote, in a letter to his confidante Frenicle, that the fact that n divides $2^n - 2$ whenever n is prime is not an isolated phenomenon. Indeed that, if n is prime then

- (2) n divides $a^n - a$ for all integers a ;

which implies that

If n doesn't divide $a^n - a$ for some integer a
then n is composite.

So instead of considering pseudoprimes to base 2, we can consider pseudoprimes to any base a : it turns out that such pseudoprimes are rare, though some do exist. However, since base 2 pseudoprimes are rare, and base 3 pseudoprimes are also rare, one would guess that numbers that are both base 2 and base 3 pseudoprimes must be extremely rare; perhaps none exist at all? Unfortunately some do exist, such as 2701, which divides both $2^{2701} - 2$ and $3^{2701} - 3$, yet $2701 = 37 \times 73$ is composite. Numbers that are pseudoprimes to bases 2, 3, and 5 simultaneously should be even rarer, but again do exist, for instance $n = 181 \times 361$; and, indeed, there are examples for any finite set of bases. So maybe we should ask whether there are any composite numbers n that are pseudoprime for every base a , that is, for which (2) holds. Such a number n would have to have certain extraordinary properties:

- (i) n must be squarefree, else if p^2 divides n then p^2 divides n divides $p^n - p$ which is false.
- (ii) If prime p divides n then $p - 1$ must divide $n - 1$, for if a is a primitive root mod p then a has order $p - 1 \pmod p$, but $a^{n-1} \equiv 1 \pmod p$ by (2).

In 1899 Korselt⁵ observed that these two conditions imply that (2) holds (which the reader may verify—hint: use the Chinese Remainder Theorem). We thus state

Korselt's criterion: n divides $a^n - a$ for all integers a if and only if n is squarefree and $p - 1$ divides $n - 1$ for all primes p dividing n .

So now, to determine whether (2) holds for n , we need only

³Then we get the sequence $n, 2^n - 1, 2^{2^n - 1} - 1, 2^{2^{2^n - 1} - 1} - 1, \dots$ of base 2 pseudoprimes by iterating this observation.

⁴For those readers not accustomed to such "estimates", we note that, $e^{(\log x)^c}$ is larger than any given power of $\log x$, and smaller than any given (positive) power of x , for sufficiently large x .

⁵responding to a "Problème Chinois" from *L'Intermédiaire des Mathématiciens*, a turn-of-the-century French journal similar to today's *The American Mathematical Monthly*

verify a few simple properties of its prime factors. Korselt did not exhibit an example of such an integer n , and he might have thought that no such n exist. However, such n do exist, as was discovered by Carmichael in 1910, the smallest being $561 = 3 \times 11 \times 17$. These numbers are now known as *Carmichael numbers*, but surely would have been known as Korselt numbers had he just done a few computations!

The first few Carmichael numbers are

$$\begin{aligned}561 &= 3 \times 11 \times 17 \\1105 &= 5 \times 13 \times 17 \\1729^* &= 7 \times 13 \times 19 \\2465 &= 5 \times 17 \times 29 \\2821 &= 7 \times 13 \times 31\end{aligned}$$

Notice how they all have three prime factors. To obtain one with four prime factors we must go out to

$$41041 = 7 \times 11 \times 13 \times 41$$

and for five prime factors to

$$825265 = 5 \times 7 \times 17 \times 19 \times 73.$$

Carmichael computed fifteen such numbers in his 1912 paper and stated that “*this list might be indefinitely extended*”. However, it soon became apparent that it was going to be difficult to prove that his list could be so lengthened, and this statement has since been considered an open problem.⁶

Korselt’s criterion may be rewritten as follows:

$n = p_1 p_2 \cdots p_k$ is a Carmichael number if and only if the p_i ’s are distinct and $L = \text{LCM}[p_1 - 1, p_2 - 1, \dots, p_k - 1]$ divides $n - 1$.

So, to verify that those numbers listed above are indeed Carmichael numbers, we only need check that $L = 80 = \text{LCM}[2, 10, 16]$ divides 560, that $L = 48$ divides 1104, that $L = 36$ divides 1728, that $L = 112$ divides 2464, that $L = 60$ divides 2820, that $L = 120$ divides 41040, and finally that $L = 144$ divides 825264. Notice that L is extremely small compared to $n - 1$ in each example, which gives us a hint as to how to find more Carmichael numbers: Let’s try to find a set of primes where these primes minus one have a surprisingly small common multiple. For example, since the prime divisors of 1729 are $p = 6 + 1$, $q = 12 + 1$, $r = 18 + 1$ giving $L = 36$, we can generalize this to

$$(3) \quad p = 6k + 1, \quad q = 12k + 1, \quad r = 18k + 1,$$

*1729 is best known from the story of when Hardy visited Ramanujan in the hospital, and pronounced his taxicab number, 1729, to be a dull number. Ramanujan refuted this by noting that it is the smallest number that is the sum of two cubes in two different ways. However, Ramanujan didn’t say that 1729 is also interesting as being the third smallest Carmichael number! Carl Pomerance further observes that the second smallest Carmichael number, 1105, is the sum of two squares in more ways than any preceding number. We leave it to the reader to come up with the analogous remark for 561, the smallest Carmichael number!

⁶See Alford’s forthcoming paper *Chasing Carmichael numbers* for a revealing discussion of Carmichael’s paper.

for integers $k \geq 1$, giving $L = 36k$. Since $pqr - 1 = 36k(36k^2 + 11k + 1)$, Korselt’s criterion tells us that pqr is a Carmichael number provided each of p , q , and r are prime. It is easy to find many values of k for which the three numbers in (3) are simultaneously prime, but can we prove that there are infinitely many such k ? This is considered an outstandingly difficult open problem in analytic number theory, and although experts are certain that infinitely many such k do exist, there have been no plausible ideas as to how to prove such a result.

One can obtain other sequences in which one expects infinitely many prime triplets or quadruplets or quintuplets, which would give rise to infinitely many Carmichael numbers, for instance

$$\begin{aligned}(12k + 5)(36k + 13)(48k + 17), & \quad (6k + 7)(12k + 13)(18k + 19), \\(28k + 5)(112k + 17)(196k + 29), & \quad (30k + 7)(60k + 13)(150k + 31), \\(180k + 7)(300k + 11)(360k + 13)(1200k + 41); & \end{aligned}$$

but it seems unlikely that this approach will lead to a proof that there are infinitely many Carmichael numbers in the foreseeable future.

Let $C(x)$ be the number of Carmichael numbers up to x . The following table gives the number of Carmichael numbers up to various values of x :

x	$C(x)$	Year	Discoverer(s)
10^3	1	1910	Carmichael
10^4	7	1912	Carmichael
10^5	16		
10^6	43		
10^7	105		
10^8	255	1938	Poulet
10^9	646	1975	Swift
10^{10}	1547		
2.5×10^{10}	2163	1980	Pomerance, Selfridge, Wagstaff
10^{11}	3605		
10^{12}	8241	1990	Jaeschke
10^{13}	19279		
10^{14}	44706		
10^{15}	105212	1992	Pinch

This data suggests that there must indeed be infinitely many Carmichael numbers, even though they remain fairly scarce all the way up to 10^{15} . In 1949 Paul Erdős showed quite how scarce Carmichael numbers are, by proving that the sums of their reciprocals converge⁷; it has since been proved that

$$(4)^\dagger \quad C(x) \leq x^{1 - \{1 + o(1)\} \log \log \log x / \log \log x}$$

In 1956 Erdős took a radically different approach to constructing Carmichael numbers. Earlier we noted that $L = \text{LCM}[p_1 - 1, \dots, p_k - 1]$ is much smaller than $n - 1$ for most Carmichael numbers $n = p_1 \cdots p_k$. However, for a typical set of primes, $\{p_1, \dots, p_k\}$, there is no particular reason to expect this to happen; indeed we’d expect L to be just a bit smaller

⁷Unlike the primes, whose sums of reciprocals diverge.

[†]For those not accustomed to such estimates, this is larger than $x^{1-\epsilon}$ for any fixed $\epsilon > 0$, but smaller than any given positive constant times x , once x is sufficiently large.

than $n - 1$. So to construct Carmichael numbers we must find some way of forcing L to be small. In our constructions above (like (3)), we selected our primes p to have certain special forms: this guaranteed that the $p - 1$ had large common divisors, forcing L to be small compared to $n - 1$. Erdős approached this problem from the other direction. Instead of choosing primes in special ways so as to force L to be small, he chose L so that there are many primes p for which $p - 1$ divides L . Once this is done, one need only find a subset of these primes, say $p_1, p_2, \dots, p_k$, for which $n = p_1 p_2 \cdots p_k \equiv 1 \pmod{L}$, to obtain the Carmichael number n — one sees that n is a Carmichael number, by using Korselt's criterion, since n is squarefree, and each $p_i - 1$ divides L , which divides $n - 1$. Let's review.

Erdős's construction of Carmichael numbers

- (i) Select integer L ;
- (ii) Determine primes p for which $p - 1$ divides L , but p does not divide L ;
- (iii) Find a subset of the primes obtained in (ii) whose product is $\equiv 1 \pmod{L}$.

This product is a Carmichael number.

As an example, let's try (i) $L = 120$. The primes p that do not divide 120, but for which $p - 1$ does divide 120, are (ii) 7, 11, 13, 31, 41, 61. Checking through all subsets of these primes we find that (iii) $41041 = 7 \times 11 \times 13 \times 41 \equiv 1 \pmod{120}$, and $172081 = 7 \times 13 \times 31 \times 61 \equiv 1 \pmod{120}$, and $852841 = 11 \times 31 \times 41 \times 61 \equiv 1 \pmod{120}$, so that 41041, 172081, and 852841 are all Carmichael numbers.

With bigger, highly composite, values of L , we expect to find many more Carmichael numbers. Indeed, if we obtain r different primes in step (ii) above, then there are $2^r - 1$ distinct products of nontrivial subsets of these primes. It seems plausible that roughly $1/L$ of these products are $\equiv 1 \pmod{L}$, and so we would have approximately $2^r/L$ Carmichael numbers so formed. It can be shown that if L is the product of all the primes up to some sufficiently large point, then we can obtain more than $2 \log^3 L$ primes in (ii), and so we'd expect more than $L^{\log^2 L}$ such Carmichael numbers. Erdős gave a similarly reasoned argument to justify his conjecture that for any fixed $\epsilon > 0$, there are more than $x^{1-\epsilon}$ Carmichael numbers up to x , once x is large enough.⁸

However, we see from our table above that the Carmichael numbers remain scarce all the way up to 10^{15} , which is surprising if Erdős's conjecture is to be believed. Indeed, Dan Shanks, in his book *Solved and Unsolved Problems in Number Theory*, challenged those who believe Erdős's conjecture to produce a value of x for which there are more than $x^{1/2}$ Carmichael numbers up to x . (Note that up to $x = 10^{15}$, there are only a few more than $x^{1/3}$ Carmichael numbers.)

It is important to note that Erdős's construction is impractical, both theoretically and computationally, if one doesn't know how to find products, of the primes produced in (ii), that are $\equiv 1 \pmod{L}$, as required for (iii). At the beginning of this

year, there were fewer than ten thousand Carmichael numbers known, and it seemed to be a very difficult task to find many more. Then, suddenly on January 21, "Red" Alford announced that he had proven the existence of at least 2^{128} Carmichael numbers! Unlike previous computations, which had sought all the Carmichael numbers up to some pre-assigned limit, or had found many in certain sequences (such as in that given by (3)), Alford modified Erdős's construction so as to make it computationally practical: As we've already discussed, it is easy (computationally) to implement steps (i) and (ii) above, but how can we find subsets of the primes in (ii) whose product is $\equiv 1 \pmod{L}$? Here's Alford's idea:

- (iia) Find a subset P of the primes in (ii), such that for every a , $1 \leq a \leq L$ with $\gcd(a, L) = 1$, there is a subset $p_1, \dots, p_k$ of P for which $p_1 p_2 \cdots p_k \equiv a \pmod{L}$;
- (iib) Let Q be the primes found in (ii), excluding those belonging to P . For any subset $q_1, \dots, q_r$ of these primes, let a be that integer, $1 \leq a \leq L$, that is $\equiv (q_1 q_2 \cdots q_r)^{-1} \pmod{L}$. From (iia) we know that there is a subset $p_1, \dots, p_k$ of P for which $p_1 \cdots p_k \equiv a \equiv (q_1 \cdots q_r)^{-1} \pmod{L}$, and so $p_1 \cdots p_k q_1 \cdots q_r \equiv 1 \pmod{L}$. Therefore, by Erdős's construction, $p_1 \cdots p_k q_1 \cdots q_r$ is a Carmichael number.

Thus, for each different nontrivial subset of Q we've constructed a different Carmichael number, providing a total of at least $2^{|Q|} - 1$ Carmichael numbers. This method is very practical, since we don't need to explicitly write down the Carmichael numbers constructed in (iib) to be guaranteed of their existence; all we need know is that there is some product of the primes in P in the congruence class $(q_1 q_2 \cdots q_r)^{-1} \pmod{L}$ corresponding to each subset $q_1, \dots, q_r$ of Q .

It remains to find a suitable set P in (iia). To do this, suppose that the primes found in (ii) were $p_1 < p_2 < \cdots < p_m$, and define R_j to be the set of products $\pmod{L}$ of the subsets of $p_1, p_2, \dots, p_j$. We easily obtain R_{j+1} from R_j by observing that $R_{j+1} = R_j \cup \{rp_{j+1} \pmod{L} : r \in R_j\}$. Once we find j for which R_j is the set of all residue classes $a \pmod{L}$ with $1 \leq a \leq L$ and $(a, L) = 1$, then we can take $P = R_j$ and we're done.

Alford worked with the example (i) $L = 2^6 \cdot 3^3 \cdot 5^2 \cdot 7^2 \cdot 11$, and found that there are (ii) 155 primes $p \geq 13$ such that $p - 1$ divides L . By computing $R_1, R_2, \dots$ as above he got (iia) $P = R_{27}$, that is, that every residue class $a \pmod{L}$ with $(a, L) = 1$ is given by the product of some subset of the smallest 27 primes found in (ii). Thus if Q is the set of the largest 128 ($= 155 - 27$) primes found in (ii) then, as described above, each subset of Q corresponds to a Carmichael number, and we've proved the existence of at least $2^{128} - 1$ Carmichael numbers.

So, in an afternoon's work, Alford increased the number of Carmichael numbers known from fewer than 2^{14} , to more than 2^{128} . Certain faculty members, here at the University of Georgia, taunted the number theory group that there cannot be interesting finite sets that contain more than 2^{128} elements, and that surely Alford's idea should provide sufficient impetus to finally prove that there are infinitely many Carmichael

⁸Taking his argument to its limit, one expects $C(x)$ to be approximately the size of the function in (4).

numbers. And indeed it did. The theorem that we eventually proved is

Theorem. (Alford, Granville, Pomerance—1992): *There are more than $x^{2/7}$ Carmichael numbers up to x , once x is sufficiently large.*

To make Erdős's construction theoretically practical, one evidently needs a result which guarantees that, given enough primes satisfying (ii), there is some subset whose product is $\equiv 1 \pmod{L}$. A theorem of van Emde Boas and Kruyswijk implies that if $m > 2$ is the largest order of an element of the multiplicative group modulo L , then such a subset exists provided there are more than $m \log L$ primes satisfying (ii). A theorem of Prachar guarantees the existence of integers L for which there are more than $L^{c/\log \log L}$ primes p satisfying (ii); however, this quantity is usually a lot smaller than $m \log L$. To avoid this difficulty one wishes to select L so that m is very small, but Prachar's construction doesn't allow this. So instead we showed the existence of integers L of the form $L'k$ with $(L', k) = 1$, where the maximal order m' of an element modulo L' is extremely small, and there are more than $m' \log L$ primes p satisfying (ii), each with the additional property that $p \equiv 1 \pmod{k}$. The result of van Emde Boas and Kruyswijk then guarantees the existence of a subset of these primes whose product is $1 \pmod{L'}$ and, since any such product is $1 \pmod{k}$ (as each such prime is $1 \pmod{k}$), thus this product is $1 \pmod{L}$, and so a Carmichael number, from Erdős's construction.

Filling in the details of this outline involves some deep tools from analytic number theory, as well as combinatorial techniques involving groups and sets. This will all be described in detail in a forthcoming journal article.

One ingredient needed for the proof is a lower bound for the number of primes in certain arithmetic progressions: As is well known, there are asymptotically $x/\log x$ primes up to x , and we expect these to be more-or-less equally distributed amongst the arithmetic progressions $a \pmod{d}$ with $(a, d) = 1$, provided d is a little smaller than x . Currently, it is only known how to prove such a result if d is considerably smaller than x , in fact smaller than a fixed power of $\log x$. However, for our purposes, we proved

Fix $\epsilon > 0$. If x is sufficiently large then for all, but a few⁹, integers $d \leq x^{5/12-\epsilon}$ there are more than $x/2d \log x$ primes $\leq x$ in the arithmetic progression $1 \pmod{d}$.

It is widely believed that such a result holds for any $d \leq x^{1-\epsilon}$. If true this implies Erdős's conjecture, for we also proved

Theorem. (Alford, Granville, Pomerance—1992): *Fix $\epsilon > 0$. Assume that, for sufficiently large x , the arithmetic progression $1 \pmod{d}$ contains more than $x/2d \log x$ primes up to x provided $d \leq x^{1-\epsilon}$. Then there are more than $x^{1-2\epsilon}$ Carmichael numbers up to x , once x is sufficiently large.*

This theorem seems to guarantee that Erdős's conjecture is correct. So, in answer to Shanks's challenge to find an x for

which $C(x) > x^{1/2}$, one can extrapolate our tabulated values of $\log C(x)/\log x$ to guess that one needs x to be around 10^{60} —it wouldn't be feasible to write down all the Carmichael numbers up to this point!!

So what does all this tell us about primality tests? Although there are various methods known that will verify that a given number is prime in a "small" number of steps (thanks to Miller, Goldwasser and Killian, Adleman and Huang, and others), they all consist of checking a large number of conditions (polynomial in the number of digits of n). It would be more elegant if one only needed to check a finite number of such conditions, but it now seems unlikely that any such method proposed thus far will work.

In particular, there are various widely-used software packages that assert that a given integer is prime if it is a "strong pseudoprime" for some given finite set of bases. However, we can prove that, for any given finite set of bases, there are infinitely many Carmichael numbers that are "strong pseudoprimes" to all the bases in that set. Such numbers would be falsely identified as prime by such software packages, so reader, beware!

Comparative CAS Reviews

Barry Simon*

Symbolic Math: Problems and Solutions

I've recently written a review for *PC Magazine* of five symbolic math packages (*Derive*, *Maple*, *Mathematica* for DOS, *Mathematica* for Windows, and *Reduce*)—it is scheduled for issue #14 of 1992 and should be out by the time this appears.

As in *PC Magazine*'s last round up in 1990, part of the test procedure was to supply the vendor with a list of twenty problems to solve with their software. We'll present the problems and solutions here.

Macsyma was not included in this review because there hasn't been a significant upgrade since it was reviewed in 1990; the vendor plans a new release later this year. *MathCAD* 3.0 includes some symbolics licensed from *Maple*, but it's a small subset and doesn't change *MathCAD*'s focus on quick and dirty calculations rather than medium/large projects.

Some comments on the problems and results before turning to the specifics (these are my opinions and not necessarily those of *PC Magazine*!):

- *Reduce* and *Derive* will post the solutions on their electronic BBS. For *Reduce*, that's the internet address reduce-netlib@rand.org

⁹A precise description of "but a few" is: There exists an integer c (depending only on ϵ) such that there is a set B of no more than c integers, each $> \log x$, such that we must miss out all those d above that are divisible by an element of B .

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while for *Derive* it is 217-337-0926.

- This round of tests included some medium length projects (17, 20, and, to a lesser extent, 18 and 19) as well as short problems. But for many users, the true test is a long project, which just can't be reasonably simulated under the time scales and circumstances of this review. You can get a feel for somewhat larger projects by looking at some of the books out on these programs—I especially recommend Gray and Glynn's *Exploring Mathematics with Mathematica* (Addison Wesley, ISBN 0-201-52818-5, \$31.95 PB, \$42.95 HC).

- Timing tests were done on the short problems on a 386/25 with 15 MB of RAM for all the products (since the common kernel was involved, we only tested *Mathematica* for DOS). They are reported in Figure 1. The differences are much less significant than they were in 1990, enough so that I don't regard them as important any more.

- To me, the biggest surprise is that neither *Mathematica* nor *Maple* would simplify $\text{Sqrt}(4+2\text{Sqrt}(3))$ and that both got the wrong answer on the gravitational potential problem (3c)!

- All programs but *Derive* require a 386 or better. All but *Derive* recommend a coprocessor. *Derive* doesn't need (or use) more than 640K of RAM. The others recommend at least 2 M of RAM, and *Mathematica* will perform poorly without 6 or 8 MB.

- *Reduce* is not yet a mature product (ironic since it is by far the "oldest" of these products). It is just starting to make the transition from hacker's cult to commercial product. It has a solid core, an eclectic collection of library functions, no graphics, and a terrible interface. But that solid core language is critical and means that a competitive product could be out based on *Reduce* before long. They are already pushing to Windows with graphics and a better interface.

- *Derive* is little changed from 1990. There has been a key addition of an IF command that accepts iterative constructions. This let them solve virtually all our problems, although the code was often convoluted. *Derive*'s virtue was its low resource usage, which is important in a world of XT's. But over 60% of the PC compatibles sold in 1991 were 386's and that trend is only accelerating with 386 machines available with VGA and hard disk for under \$1000! *Derive* makes no use of any hardware beyond an XT, and its graphics and interface are getting dated. The program is in need of a major overhaul if it is to survive.

- Robert Cringley, in his fun book *Accidental Empires*, states the 70/30 rule that most markets have a market leader with 70% of the market and a second company with the bulk of the remainder. While I've no idea of precise sales figures, it appears that *Mathematica/Maple* fit this pattern—*Mathematica* is the market leader in terms of perception, and *Maple* has the bulk of the rest.

- *Maple*'s DOS interface with the possibility of calling previous commands into a full screen editor and customizable menus is by far the slickest DOS interface. *Mathematica* for Windows' notebook interface with some word processing and outlining features lets you produce live documents and is also impressive. *Maple* for Windows, due out later this year, could

give it a run for the money on interface.

- *Mathematica*'s graphics are special. You get programmatic control of the graphics, links to standard graphics file types for import to desktop publishing programs, and more primitives. But its kernel is weak in the area of integration.

- I had a dramatic indication that how you code solutions can make a big difference. One vendor, who shall remain nameless, initially submitted a solution of problem 9 that took over 35 minutes to run. I expressed surprise at the time and that the solution was different from what I'd expected, which was just a set of rules. What I got by return email was a second solution that ran in under 2 secs!!

- *Mathematica* has added copy protection! It's worse than merely having to type in your name and having the software branded because the program records hardware information. As happens so often with copy protection, there are glitches that burn users—I was unable to run QEMM with *Mathematica* without getting a four-question inquisition after EACH command as the copy protection kicked in. American business users rebelled against copy protection roughly five years ago and forced companies to drop it. Should scientists do less?

Figure 1

Problem	<i>Derive</i>	<i>Maple</i>	<i>Mathematica</i>	<i>Reduce</i>
1a	51s	2m 15s	1m 55s	2m 3s
1c	51s	2m 40s	25s	18m 47s
2a	1s	6s	NA	6s
2b	1s	1s	1s	1s
2c	1s	1s	1s	1s
2d	2s	1s	1s	17s
3a	1s	1s	1s	1s
3b	NA	51s	NA	3s
3c	2s	NA	NA	BH
4a	4s	2s	5s	6s
4b	1s	2s	5s	BH
5	7m 22s	15s	1m 12s	2m 10s
6	14s	2s	38s	2m 48s
7a	1s	15s	59s	2s
7b	1s	4s	1s	1s
8a	1s	2s	1s	BH
8b	1s	2s	1s	1s
8c	1s	1s	43s	1s
10a	3s	1s	5s	33s
10b	2m 46s	5s	5s	13s
10c	BH	21s	1s	15s
11	7s (per sol)	25s	2s (1 sol)	1m 20s (1 sol)
12a	1s	6s	9s	43s
12b	BH	3s	NA	1m 36s
12c	1s	2s	3s	17s

Times are rounded, except any time less than 1s is listed as 1s.

BH: The problem was done by hand in multiple steps so no timing is possible.

NA: Couldn't do problem.

Vendor Information

Note: These products have academic and/or site license discounts.

Derive, Version 2.10

Soft Warehouse
3660 Walalae Ave., Suite 304
Honolulu, HI 96818

808-734-5801

Price: \$250; \$289 for an HP 95LX Rom card

Student Edition: Available from Addison-Wesley,

800-527-5210, \$50

Maple V, Version 1.1

Waterloo Maple Software

160 Columbia St. West

Waterloo, Ontario, Canada N2L 3L3

519-747-2373

Price: \$695

Student Edition: Available from

Brooks/Cole, 408-373-0728, \$99

Mathematica for DOS, Version 2.0

Mathematica for Windows, Version 2.0

100 Trade Center Drive

Champaign, Ill. 61820

800-441-6284

217-398-0700

Price: \$995 for Windows version;

\$895 for enhanced DOS

(coprocessor) version;

\$595 for standard DOS (won't use a

coprocessor) version.

Student price for standard DOS version: \$175

Reduce, Version 3.4

Calcode Systems

1057 Amoroso Place

Venice, CA 90291

310-399-7612

Price: \$495

In the UK: Codemist Ltd,

"Alta", Horsecombe Vale,

Combe Down, Bath BA2 5QR, UK +44-225-837-430

In Germany: Konrad-Zuse-Zentrum

fuer Informationstechnik Berlin,

Attn: Herbert Melenk,

Heilbronner Str. 10, D 1000 Berlin 31, GERMANY,

+49-30-89604-195

The Problems and Solutions

{Note: Problems 2a, 2b, 3c, 4a, and 4b are suggested by Kahane. Problem 12 is unchanged from last time.}

1. Hilbert Matrices: Invert a 30×30 Hilbert matrix—this is a matrix whose i,j element (with elements starting at 1,1) is

$(1/(i+j-1))$.

(a) First use exact rational arithmetic.

(b) Then provide a way to estimate the number of decimal places needed to be sure that $M \cdot M^{-1}$ is the identity to one part in 10^6 and

(c) provide the numerical inverse for this accuracy.

Note: M has elements of order 10^{-42} so 50 place accuracy was used for 1c.

Derive Problem 1a:

$HILBERT(n):=VECTOR(VECTOR(1/(i+j-1),j,1,n),i,1,n)$

$HILBERT(30)^{-1}$

Then choose Simplify from the menu.

Note: While I could do the calculation, I was unable to examine the answer or continue (except to exit) without getting an out-of-memory error.

Derive Problem 1c:

Same as 1a, only choose Options Precision Exact 50, then Options Notation Decimal, then use Approx rather than Simplify. Actually, you run out of memory if you ask for the full inverse but you can ask for something like the maximum element (which is where the time comes from). The vendor remarks that even though the matrix elements are of order 10^{-42} , taking 42 place accuracy suffices in *Derive* because of the method of rational approximation of decimals that is used!

Maple Problem 1a: with(linalg):

$h:=hilbert(30);$

$ih:=inverse(h);$

"With" loads an external library

Maple Problem 1c: digits = 50

$fh:=map(evalf,eval(h));$

$ifh:=inverse(fh);$

The map function says to apply evalf to each element of the matrix and evalf forces rational numbers to be floating point.

Mathematica Problem 1a, c:

$HilbertMatrix[n_]:=Table[1/(i+j-1),\{i,n\},\{j,n\}]$

$matrix = HilbertMatrix[30];$

$inverse = Inverse[matrix];$

$t = SetPrecision[matrix,50];$

$inverse = Inverse[t];$

Reduce general remark: Expressions in the language end in ; (answer displayed) or \$ (answer not displayed). Comments start with %.

Reduce Problem 1a: matrix m(30,30):

for i:=1:30 do for j:= 1:30 do m(i,j):= 1/(i+j-1);
1/m;

Reduce Problem 1c: Given the definition of m:

on rounded;

precision 50; 1/m;

off rounded;

2. Simplifications

(a) Simplify $\{4 + 2(3)^{(1/2)}\}^{(1/2)}$

(b) Simplify $(3+4I)^{(1/2)}$ {Here $I=\sqrt{-1}$ }

(c) Expand $\tan(X+Y)$

(d) Compute to 6 digit accuracy (at least) $\tan(10^{100})$

Derive Problems 2a, b: Type in and choose Simplify; worked fine.

Derive Problem 2c: Type in Manage Trigonometry Expand from the menu and then Simplify. Gives answer in terms of sin/cos; not tan.

Derive Problem 2d: Options Precision Exact N with N at least 107 (we used 200) and

then Author and type in $\tan(10^{100})$. Approx will give answer which is

0.40123196199081435418575434365329495832387...

Maple Problem 2a: Such simplifications are not built in!

```
q2a := (4+2*3^(1/2))^(1/2);
t := convert(q2a,RootOf);
t1 := traperror(evala(Normal(t)));
if t1 = lasterror then
  t1 := map(rhs, t1[2]);
t1 := select(proc(x) evalb(evalf(x,10)=evalf(q2a,10))
end, t1);
a2a := convert(op(t1),radical);
else
  a2a := convert(t1,radical);
fi;
```

Maple Problem 2b: This is built in!

$a2b := \sqrt{3+4\sqrt{1}}$

Maple Problem 2c:

```
q2c := tan(x+y);
a2c := expand(q2c);
# optional: express in terms of tan(x) and tan(y)
normal(eval(subs(sin=(a -> tan(a)*cos(a)),a2c)));
```

Maple Problem 2d:

```
q2d := tan(10^100);
a2d := evalf(evalf(q2d,106),6)
```

Mathematica Problem 2a:

```
expr := (4 + 2 (3)^(1/2))^(1/2)
Expand[expr]
```

The answer given though was $\sqrt{2} \sqrt{2 + \sqrt{3}}$, NOT the expected $1 + \sqrt{3}$. And trying $\text{Solve}[x^2 - 4 - 2\sqrt{3} = 0, x]$ didn't yield the simplified answer (although such a solve command did coax the answer from *Maple* and *Reduce*). However, one can use *Mathematica*'s ability to recognize approximations to algebraic numbers. So, rather bizarrely, you can take the exact expression, make a real approximation and then have the program recognize that the resulting reals are close to $1 + \sqrt{3}$. So this alternate code was provided:

```
Needs["NumberTheory`Recognize`"]
```

```
Solve[ Recognize[N[ Sqrt[4 + 2 Sqrt[3]] ],2,t] == 0,
t]//Simplify
```

Mathematica Problem 2b:

```
(3 + 4 I)^(1/2)
gave 2+I.
```

Mathematica Problem 2c:

```
Needs["Algebra`Trigonometry`"]
```

```
TrigReduce[Tan[x + y]]
```

gave the right answer. The Needs command loads an external library.

Mathematica Problem 2d:

```
N[Tan[10^100],110]
```

says to work to 110 place accuracy.

Reduce Problem 2a: Here's the solution—had to be worked out "by hand":

% The standard REDUCE simplifier doesn't handle either of these cases

% directly, so we solve them as factorization problems.

```
load_package arnum;
```

```
defpoly sqrt3**2 - 3;
```

```
factorize(x**2 - (4+2*sqrt3)); % Factoring over algebraic
domain sqrt(3).
```

% So $\{4 + 2(3)^{1/2}\}^{1/2}$ is one of the expressions:

```
for each j in ws collect -sub(x=0,j);
```

```
off arnum;
```

Note: ws = workspace

Reduce Problem 2b: Similar solution to 2a

Reduce Problem 2c: Not built in but

% We show this solution to demonstrate REDUCE's pattern matching.

```
(tan(x+y) where {tan(~x)=sin(x)/cos(x),
cos(~x+~y)=cos(x)*cos(y)-sin(x)*sin(y),
sin(~x+~y)=sin(x)*cos(y)+cos(x)*sin(y)})
where sin(~x)=cos(x)*tan(x);
```

Reduce Problem 2d:

```
on rounded;
```

```
precision 120;
```

```
print_precision 20;
```

```
tan(10^100);
```

```
precision 12;
```

```
off rounded;
```

3. Symbolic Integration and Differentiation:

(a) Take the derivative of $x^{10} * (\cos(x^5 * \ln(x)))^{1/2}$

(b) Symbolically integrate the derivative computed in 2(a)

(c) Compute the gravitational potential of a sphere in spherical coordinates—explicitly as a function of x compute the double integral in r, t for $0 < r < 1$ and $0 < t < \pi$ of

$$r^2 * \sin(t) / \{x^2 + r^2 - 2xr \cos(t)\}^{1/2}$$

Derive Problem 3a: Enter function and choose Calculus Differentiate x 1

Derive Problem 3b: "Derive can't determine the antiderivative. For other systems I suggest that you save the derivative result and load it into a fresh session because they might simply remember the origin of the derivative." (which is what I did!)

Derive Problem 3c: Enter

```
INT(INT(r^2*SIN(theta)/SQRT(x^2+r^2-
```

$2*x*r*\text{COS}(\text{theta}), \text{theta}, 0, \pi), r, 0, 1)$
and choose Simplify from the menu. The form of the answer given was $(x^2+x-2)*\text{ABS}(x-1)/(6*x)-(x^2-x-2)*\text{ABS}(x+1)/(6*x)$. This was the only automated correct solution!

Maple Problem 3a:

$q3a := x^{10} * (\cos(x^5 * \ln(x)))^{(1/2)};$
 $a3a := \text{diff}(q3a, x);$

Maple Problem 3b:

$a3b := \text{int}(a3a, x);$

The answer came out in a complicated rewriting of the original function, to whit:

$1/2 \sqrt{2} * (a/b + c/b)$

where a, b, c were written out with (here $d = I x^5$)

$b = \sqrt{x^{(2d)+1)}$

$a = x^{(3/2 d + 10)}$

$c = x^{(-1/2 d + 10)}$.

Maple Problem 3c: “Maple get $\text{int}(\text{int}(q3c, t=0..Pi), r=0..1) = 1$, which is wrong.” (!!!). A way of doing the integral in steps fixing the signs by hand was provided.

Mathematica Problems 3a,b:

$\text{deriv} = D[x^{10} (\text{Cos}[x^5] \text{Log}[x])^{(1/2)}, x]$

worked but $\text{Integrate}[\text{deriv}, x]$ did not return a completely integrated expression.

Mathematica Problem 3c:

$\text{Integrate}[r^2 \text{Sin}[th]/(x^2 + r^2 - 2 x r \text{Cos}[th])^{(1/2)}, \{r, 0, 1\}, \{th, 0, \text{Pi}\}]$
returned

$$\frac{(2-3x)\sqrt{(1-x)^2}}{-6x+6x^2} + \frac{\sqrt{(1+x)^2}(2+3x)}{6x+6x^2}$$

which is the wrong answer for $x < 1$ (but correct if $x > 1$).

Reduce Problems 3a, b:

$\text{df}(x^{10} * (\cos(x^5 * \log(x)))^{(1/2)}, x);$
 $\text{int}(ws, x);$

Reduce Problem 3c: Reduce doesn't do definite integrals. So a solution by hand was provided where, at a critical point, the sign of a square root was flipped!

4. Limits

(a) Compute the limit as x goes to infinity of

$$\frac{\log(x-a)}{(a-b)(a-c)} + \frac{\log(2*(x-b))}{(b-c)(b-a)} + \frac{\log(x-c)}{(c-a)(c-b)}$$

(b) Compute the limit as x goes to infinity of the inverse $1/[\exp(x) - \exp\{x - (x^{(-2)})\}]$

Derive Problem 4a,b: Enter the function in author mode and then choose Calculus Limit from the menus; infinity is entered as “inf”.

Maple Problem 4a: $a4a := \text{limit}(q4a, x = \text{infinity})$ with $q4a$ the obvious input. The answer is $-\ln(2)/(b-c)(a-b)$

Maple Problem 4b: $q4b := 1/(\exp(x) - \exp(x-1/x^2));$
 $a4b := \text{limit}(\text{expand}(q4b), x = \text{infinity});$
The answer is 0.

Mathematica Problem 4a:

$\text{Limit}[\text{Log}[x-a]/((a-b)(a-c)) + \text{Log}[2(x-b)]/((b-c)(b-a)) + \text{Log}[x-c]/((c-a)(c-b)), x \rightarrow \text{Infinity}]$
provided the right answer.

Mathematica Problem 4b:

$\text{Needs}["\text{Calculus'Limit}"]$
 $\text{Limit}[1/(\text{E}^x - \text{E}^{(x-x^{(-2)})}), x \rightarrow \text{Infinity}]$

Reduce Problem 4a:

$\text{limit}(\log(x-a)/((a-b)*(a-c)) + \log(2(x-b))/((b-c)*(b-a)) + \log(x-c)/((c-a)*(c-b)), x, \text{infinity});$

Reduce Problem 4b: Can't be handled directly so the expression is simplified (by hand!) and l'Hopital's rule is used. (Hardly counts as a solution).

5. Symbolic Sums and Factoring Polynomials

Factor over the rationals, the sum from 1 to N of j^{40} as a function of N .

Derive Problem 5: Use Calculus Sum to enter the sum and then Simplify.

Maple Problem 5: $a5a := \text{sum}(j^{40}, j=1..N);$
 $a5b := \text{factor}(a5a);$

Mathematica Problem 5:

$\text{Needs}["\text{Algebra'SymbolicSum}"]$
 $\text{sum} = \text{SymbolicSum}[j^{40}, \{j, 1, n\}];$
 $\text{Factor}[\text{sum}]$

Reduce Problem 5:

$\text{sum}(j^{40}, j, 1, n)$
on factor;
 $ws;$
off factor;

6. Prime Testing

Find the next prime after 10^{80}

Derive Problem 6: Enter $\text{NEXT_PRIME}(10^{80})$ and Choose Simplify from the menu. The answer is $10^{80}+129$. All these programs use a probabilistic approach so it is guaranteed this is a prime but it surely is.

Maple Problem 6: $a6 := \text{nextprime}(10^{80});$

Mathematica Problem 6:

$\text{Needs}["\text{NumberTheory'NumberTheoryFunctions}"]$
 $\text{NextPrime}[10^{80}]$

Reduce Problem 6: $\text{nextprime}(10^{80});$

7. Integer Factoring

(a) Factor 98765432123456789 over the integers.

(b) Factor 13 over the Gaussian integers. (Gaussian integers are of the form $a+bi$ with a, b integers; note factorization is NOT unique; you should try to find ALL factorizations into Gaussian primes.)

Derive Problem 7a: Enter the number and choose Factor from the menu.

The answer is 449 494927 444444443.

Derive Problem 7b: An expression was provided for primes that gave their Gaussian factors explicitly (depending on whether p is congruent to 1 or 3 mod 4). The prescription is to factor and then apply this function to each prime.

Maple Problem 7a: `a7a:=ifactor(98765432123456789);`

Maple Problem 7b: Gaussian factorization will be in the next release of *Maple* but for now the solution is via knowing the way Gaussian factorization takes place—namely solving a Diophantine equation:

`t := {solve(a^2+b^2=13)};`

`a7b := map(proc(x) subs(x,a+I*b); “evalc(13/)” end,t);`

Mathematica Problem 7:

`FactorInteger[98765432123456789]`

`FactorInteger[13,GaussianIntegers→True]`

Currently, the only package that offers built-in support for Gaussian integers.

Reduce Problem 7a: (typical of mode turning on/off)

on ifactor;

factorize 98765432123456789;

off ifactor;

Reduce Problem 7b: Custom code

procedure try_fact_squares n;

% See if the prime (over integers) n is the sum of two positive squares.

begin

scalar j;

j := 1;

top:

m := sqrt(n-j*j);

if m*m+j*j = n then return list ((m+i*j),(m-i*j));

j := j+1;

if j*j < n/2 then goto top;

return list n;

end;

procedure factor_integer_over_complex n;

begin

scalar facts;

on ifactor;

facts := factorize n;

return for each k in facts join try_fact_squares k;

end;

factor_integer_over_complex 13;

8. Infinite Sums and Integrals

(a) Compute the sum of $j^{(-6)}$ for j from 1 to infinity.

(b) Compute the integral from 0 to infinity of $x^{(7/2)} * \exp(-x^3)$.

(c) Compute the integral from 0 to infinity of $x^{(7)} * \exp(-x^3)$.

If possible see if the answer has an exact answer in terms of π , etc.

Derive Problem 8: Enter the sum, integral via the Calculus submenu and Simplify. The answers are $\pi^6/945$, $\text{Sqrt}(\pi)/6$ and $5/9*(\text{Gamma}(5/3))=0.501525$

Maple Problem 8: `a8a:=sum(1/j^6,j=1..infinity);`

`a8b:=int(x^(7/2)*exp(-x^3),x=0..infinity);`

`a8c:=int(x^7*exp(-x^3),x=0..infinity);`

Mathematica Problem 8:

`Sum[j^(-6),{j,1,Infinity}]`

`Integrate[x^(7/2) Exp[-x^3],{x,0,Infinity}]`

`Integrate[x^7 Exp[-x^3],{x,0,Infinity}]`

Reduce doesn't do definite integrals per se, but solutions of sorts were provided:

Reduce Problem 8a: Solved using residue calculus knowledge; hardly counts as a solution:

`load_package taylor;`

`resid := coeffn(taylor(tostandard taylor(z/tan(pi*z),z,0,6),z,6))$`

Reduce Problem 8b,c: Loaded Laplace Transform package and did change of variable by hand.

9. Rule Based Algebra

Consider the Clifford algebra in 10 variables, that is, the complex algebra with ten generators, $s_0, \dots, s_9$ obeying

$s_i s_j + s_j s_i = 0$ if i is different from j

$s_i s_i = 1$

That is, multiplication is NOT commutative (but is assumed associative). Compute

$(s_0 + s_1 + \dots + s_9)^5$

NOTE: This must be done with general methods—it is cheating to use the invariance of the Clifford algebra under orthogonal transformations.

Derive Problem 9: A solution was provided with 55 lines of function definition of which the following is typical:

`ADD_AUX(u,v,j,k):=~`

`IF(j=0,HEAD(v,k),~`

`IF(k=0,HEAD(u,j),~`

`IF(SIMILAR(ELEMENT(u,j),ELEMENT(v,k)),~`

`APPEND(ADD_AUX(u,v,j-1,k-1),~`

`ADDSIMILAR(ELEMENT(ELEMENT(u,j),1)+`

`ELEMENT(ELEMENT(v,k),1),ELEMENT(u,j)),~`

`IF(BEFORE(ELEMENT(u,j),ELEMENT(v,k)),~`

`APPEND(ADD_AUX(u,v,j,k-1),[ELEMENT(v,k)],~`

`APPEND(ADD_AUX(u,v,j-1,k),[ELEMENT(u,j)])))))`

Anyone who thinks you can't program with just an IF statement should look at this. It's awkward but certainly doable! The answer, by the way, is 100 times the sum of the sigmas.

Maple Problem 9: Here's the code to set up the rule based algebra:

```
s.(0..9):
readlib(commutat):
for i from 0 to 9 do
  for j from i+1 to 9 do
    &*(s.j,s.i) := -&*(s.i,s.j);
  od;
  &*(s.i,s.i) := 1;
od;
&^ := proc(a,n) local t;
t := 1;
to n do
  if type(t,constant) then t := t*a
  else t := expand(t&*a)
  fi
od;
t
end;
q9 := sum('s.k',k=0..9);
a9:=q9&^5;
```

Mathematica Problem 9:

```
(* rules for Clifford algebra *)
ncm[s[i_],s[j_]] := -ncm[s[j], s[i]]/i > j
ncm[s[i_], s[i_]] := 1
(* rules for noncommutative multiplication *)
(* - behavior of multiplication of integers *)
ncm[a_?NumberQ, b_?NumberQ, c_] := ncm[a b, c]
(* - distributivity of addition *)
ncm[m___, a.Plus,b.Plus, n___] :=
ncm[m, Distribute[tmp[a,b],Plus]/.tmp -> ncm, n]
(* - associativity *)
ncm[a___, ncm[r___], b___] := ncm[a, r, b]
(* here's the expression *)
expr = Plus @@ Map[s, Range[1,9]]
(* and here's the power. Note the output form involves
ncm; this could be formatted to look cleaner for one's
individual purposes. *) expr^5/.
x._n_ -> Fold[ncm, x, Table[x, {n - 1}]]
```

Reduce Problem 9: Shows simple elegance of the Reduce language.

```
operator s;
noncom s;
for all i,j such that i>j let s(i)*s(j)=-s(j)*s(i);
for all i let s(i)*s(i) = 1;
xxx := for i:=0:9 sum s(i);
xxx^2;
xxx*ws^2;
```

10. Polynomials in Several Variables

(a) Expand $(x+y+z)^{20}$.

(b) Now factor the polynomial in (a) over the rationals.

(c) Factor $x^4 + y^4$ over the Gaussian integers.

Derive Problem 10a: Enter Expression and Choose Expand

Derive Problem 10b: Choose Factor Rational

Derive Problem 10c: The solution suggested was to factor over the complexes and by hand pick out the factors that combine to give factors over the complex numbers.

Maple Problem 10a: Expand $((x+y+z)^{20})$;

By default, the ordering of terms in the output of such expansions appears to be random and certainly isn't organized in a useful way.

Maple Problem 10b: a10b := factor(a10a);

Maple Problem 10c:

"It is unfortunate that you ask this question at this time. Maple 5.1 has multivariate polynomial factorization over algebraic number fields and also algebraic function fields built in. Maple 5.0 can factor UNIVARIATE polynomials over ANY algebraic number field though." A twelve line program was provided instead.

Mathematica Problem 10:

```
poly = Expand[(x + y + z)^20];
Factor[poly]
Factor[x^4 + y^4, GaussianIntegers -> True]
```

Reduce Problem 10a,b:

```
(x+y+z)^20;
on factor; ws;
```

Reduce Problem 10c:

```
on complex, factor;
x**4 + y**4;
off complex,factor;
```

11. Solve Numerically the Triple of Nonlinear Equations (Real OR Complex Solutions):

$$\begin{aligned} \sin(x) + y^2 + \ln(z) &= 7 \\ 3x + 2y - z^3 &= -1 \\ x^2 + y^2 + z^3 &= 5 \end{aligned}$$

Derive Problem 11: Six approximate complex solutions were found for

Example. $x = -2.46556 - 1.69474i$, $y = -2.89745 + 0.573737i$ and $z = 0.58869 + 1.91505i$. This is done by using the Newton's method code from the supplied file Solve.Mth guessing various starting points. Each solution took about 7 seconds to find once typed in. There are no real solutions.

Maple Problem 11: A thirty line program implementing a complex Newton's method was provided; it is not built in.

Mathematica Problem 11:

```
eq1 = Sin[x] + y^2 + Log[z] == 7;
eq2 = 3x + 2^y - z^3 == -1;
eq3 = x^2 + y^2 + z^3 == 5;
FindRoot[Evaluate[{eq1,eq2,eq3}],
{x,1+I},{y,1+I},{z,1+I}] found the root
{x -> 0.339961 + 2.36119 I, y -> 2.39276 - 1.0728 I,
z -> 1.86956 + 0.34026 I}
```

Taking random starting points found another 11 roots; here's the code including code for removing duplicates from a list:

```
FindRoot[Evaluate[{eq1,eq2,eq3}],{x,1 +
I},{y,1 + I},{z,1 + I}]
fr = Table[
FindRoot[Evaluate[{eq1, eq2, eq3}], {x,#1},
{y,#2},{z,#3}]& @@
Table[Random[Complex,
{-7 - 7 I, 7 + 7 I}],{3}], {30}];
fr = Select[fr,(({eq1, eq2, eq3}/.#) === {True,
True, True})&];
removedups[{}]:= {}
removedups[list_]:=
Join[{First[list]},
removedups[Select[Rest[list],
(Chop[First[list] - #,10^-8] != {0,0,0}) &]]
]
removedups[{x,y,z}/.fr]
```

Reduce Problem 11: (This requires a package not included with *Reduce* but available via internet from Rand);

```
load_package numeric;
% This system has no real solution.
% looking for complex solutions:
sys:={sin(x)+y^2+log(z)=7,
3*x+2*y-z^3=-1,
x^2+y^2+z^3=5};
on rounded,complex;
sol1:=num.solve(sys,x=1+i,y=1+i,z=1+i);
% Found three solutions by this method
```

12. ODE's and Recursion Relations

- (a) Solve $y'' + y = \cos(x)$
 (b) Solve $x^2 \cdot (dy/dx) + 2xy - y^3 = 0$
 (c) Solve the recursion relation
 $s(n) = 3 \cdot s(n-1) - 2 \cdot s(n-2)$
 $s(1) = 1 \quad s(2) = 1$

Note: Unfortunately, I copied this problem from the last *Notices* article which had dropped a minus sign in the initial condition for $s(2)$ so the answer is identically 1!

Derive Problem 12a: Use routines from *ode2new.mth*. Need to load that and type in `LIN2_GEN(0,1,COS(x))` and use *Simplify*.

Derive Problem 12b: Depends on realizing it has Bernoulli form and knowing how to transform it. Load *ode1new.mth* and use the *Solve* on the expression

```
BERNOULLI(2/x,1/x^2,3)
```

The answer is

```
1/y^2 = (c*x^5 + 2)/5*x
```

The *Derive* solution makes it appear that there are two free parameters but there is only one.

Derive Problem 12c: Use routines from *recurnew.mth*. Need to load that type `LIN2_CCF_BV(-3,2,0,x,1,1,2,1)` and use *Simplify*.

Maple Problems 12a,b:

```
q12a := diff(y(x),x$2) + y(x)=cos(x);
a12a := dsolve(q12a,y(x));
12b is virtually identical in syntax
```

Maple Problem 12c:

```
q12c := {s(n)=3*s(n-1)-2*s(n-2),s(1)=1,s(2)=1};
a12c := rsolve(q12c,s(n));
```

Mathematica Problem 12a,b:

```
DSolve[y''[x] + y[x] == Cos[x], y[x],x]
yielded a solution but
DSolve[x^2 + y'[x] + 2 x y[x] - y[x]^3 == 0, y[x], x]
did not (although NDSolve provided a numeric solution).
```

Mathematica Problem 12c:

```
Needs["DiscreteMath`RSolve`"]
RSolve[{s[n] == 3 s[n - 1] - 2 s[n - 2],
s[1] == 1, s[2] == 1},
s[n], n]
```

Reduce Problem 12a:

```
load_package odesolve;
depend y,x;
odesolve(df(y,x,2)+y=cos(x),y,x);
```

Reduce Problem 12b: (Notice how much easier this is than *Derive*): `odesolve(x^2*df(y,x)+2x*y=y^3,y,x);`

Reduce Problem 12c:

Provided a 24 line general procedure for solving recursion relations!

```
procedure solve_lin_rec(rec,ic);
% solves homogenous linear recursion relation REC which
% has to have the form s(n)=... with initial conditions
% IC in the form of list {s(1)=?,s(2)=...}
% the method used - substitution s(n)=x^n
% like e^(lambda*x) in linear homogeneous ODE.
% Of course some checking should be added.
begin
scalar lrec,sol,msol,gsol,j;
for all n let s(n)=x^n;
lrec:=lhs rec;
rec:=rhs rec;
for all n clear s(n);
rec:=num((lrec-rec)/lrec);
j:=1;
for each a in solve(rec,x) do
<<a:=rhs a^n;
gsol:=gsol+c(j)*a;
j:=j+1;
msol:=first multiplicities!*;
multiplicities!*=rest multiplicities!*;
while msol>1 do
<<a:=n*a;
gsol:=gsol+c(j)*a;
j:=j+1;
msol:=msol-1 >> >>;
write "General solution: S(N) := ",gsol;
```

```

sol:=solve(for each a in ic collect sub(n=part(lhs a,1),gsol)
=rhs a,
for i:=1:length ic collect c(i));
% If some c(i) remains it can be arbitrary real.
let sol;
gsol:=gsol;
clearrules sol;
return gsol
end;
solve_lin_rec(s(n)=3*s(n-1)-2*s(n-2),{s(1)=1,s(2)=1});

```

13. External Conversions. Consider the function $f(x) := \exp\{-x^{(-1/2)}\} / \{\sin(x) + x^7\}$

- Translate into $\text{\TeX}$ format.
 - Translate into a C program.
- Derive* can do (b) but not (a); the other three can do both.

14. Graphing

- Graph the parametric curve:
 $x = \cos(3t) \quad y = 3 \sin(5t)$
for t from 0 to 2π
- Graph the surface
 $\sin[x + \sin(y)]$
with x, y running from 0 to 4π
- Draw an Icosohedron.
- Draw the contour surfaces of $y * \text{Sqrt}[9 - x^2]$ where x and y run from -3 to 3.
- Provide an additional graphical example that you think shows off your product.

Derive Problems 14a/b: Simple applications. Define the function.

Go to the Windows menu and split the window, set the larger window to 2D or 3D graphics, set some parameters for optimal display (requires some experimentation) and pick "plot".

Derive Problem 14c: The vendor used the vertices of the Icosahedron as found in *Mathematica*'s library (!) and entered them as a complicated data set and used the vector command.

Derive Problem 14d: You can define contours as a vector and plot the values of a vector. Color coding by height is NOT possible.

Derive Problem 14e: The vendor points out that "Unlike many packages, most discontinuities such as $\tan(x)$ or $\text{sign}(x)$ are not bridged, and false transformations such as $\arctan(\tan(x)) \rightarrow x$ are avoided", and provides a graphic sample to illustrate this.

Maple Problem 14a:

```

aspect_ratio := 1.45; # This depends on your monitor.
w := aspect_ratio*3;
a14a := plot([cos(3*t), 3*sin(5*t), t=0..2*Pi], x=-w..w, y=-
3..3, resolution=1024, style=LINE);
Once plotted, a small menu can be popped up with F10.

```

Maple Problem 14b:

```

a14b := plot3d(sin(x+sin(y)), x=0..4*Pi, y=0..4*Pi,
grid=[36,36], axes=BOXED, scaling=CONSTRAINED);

```

Maple Problem 14c: Explicit coordinates for the vertices of the Icosahedron were provided and could be used via the grid command to plot the figure. The points were generated with a little program.

Maple Problem 14d:

Maple V cannot in general draw contour surfaces, but it is possible to do it in this case.

Special code based on the particular example was provided.

Maple Problem 14e: If you have *Maple* try this lovely graphic:

Spiral Tube Around a Torus

with(plots):

N := 10;

```

a14e := tubeplot([ [10*cos(t), 10*sin(t), 0,
t=0..2*Pi, radius=2, numpoints=10*N, tubepoints=2*N]
, [cos(t)*(10+4*sin(9*t)), sin(t)*(10+4*sin(9*t)), 4*cos(9*t),
t=0..2*Pi, radius=1, numpoints=trunc(37.5*N), tubepoints=N] ],
scaling=CONSTRAINED, orientation=[76,40]);

```

Mathematica Problem 14:

- ParametricPlot[{Cos[3 t], 3 Sin[5 t]}, {t, 0, 2 Pi}]
- Plot3D[Sin[x + Sin[y]], {x, 0, 4 Pi}, {y, 0, 4 Pi}, PlotPoints -> 30]
- Needs["Graphics`Polyhedra`"] Show[Polyhedron[Icosahedron]]
- ContourPlot[y Sqrt[9 - x^2], {x, -3, 3}, {y, -3, 3}]
- Five extra graphics were provided (graphics is Mathematica's strong suit!) including
Show[Polyhedron[GreatIcosahedron]]
and
Needs["Miscellaneous`WorldPlot`"]
WorldPlot[{World, RandomColors},
WorldProjection -> Sinusoidal]
Reduce has no graphics!

15. For each of the graphs you could draw in problem 14, do the following:

- Print it out on a laser jet.
- Save it as a vector graphic file - EPS or CGM or ...
- Save it as a bitmap file - PCX or TIFF or ...

Reduce has no graphics; *Derive* has no explicit support for printing graphs or saving to a file but expects you to use third party print screen products which capture the graphic and unfortunately the on screen menu (some third party products will let you crop this menu out). *Maple* has support for many printers— you can print to a file and so capture an HPGL file. *Mathematica* has strong support for printers; the DOS version can send to a file in EPS format. The Windows version adds BMP and WMF to EPS.

16. Provide a program to draw the Koch snowflake (this is a two-dimensional "curve" obtained as a limit by the following iterative process. Start with an equilateral triangle. At each stage go to the next by adding to each side an equilateral triangle pointing outwards of side 1/3 the size of the current edges, centered on the edge; Contact me if you aren't familiar with this object already).

Clearly you'll need to end the iteration after finitely many steps. That should be a parameter in the program.

Derive Problem 16: A use of IF allows a recursive definition of the Koch snowflake (Note: multiple lines in *Derive* require a ~ continuation character, not shown here):

```
s:=3*TAN(pi/6)
EDGE(a,b,c,n):=IF(n=0,[a,b],
[EDGE(a,(2*a+b)/3,(2*a+c)/3,n-1),
EDGE((2*a+b)/3,(a+b+c)/3,(2*a+c)/3,n-1),
EDGE((a+b+c)/3,(a+2*b)/3,(2*b+c)/3,n-1),
EDGE((a+2*b)/3,b,(2*b+c)/3,n-1)])
STAR(n):=[EDGE([-s,-1],[s,-1],[0,-4],n),
EDGE([s,-1],[0,2],[2*s,2],n),
EDGE([0,2],[-s,-1],[-2*s,2],n)]
With these definitions STAR(n) is an nth order iterate
stating on the star for n=1.
```

Maple Problem 16:

```
aspect_ratio := 1.45; # This depends on your monitor.
Koch := proc(n) local n1,d,x,y,p,i,h,v;
if type(n,integer) and 0<n then
n1:=n-1; d:=3*4^n1;
x:=array(0..d); y:=array(0..d);
evalhf(Kpoint(d,var(x),var(y),n1));
p:=map(op,[seq([x[i],y[i]],i=0..d)]);
else ERROR(n must be a positive integer)
fi;
v := 3.^(1/2)/2;
h := aspect_ratio*v;
if h<1 then v:=v/h; h:=1.; fi;
PLOT(
RANGE(HORIZONTAL,-h..h),
RANGE( VERTICAL,-v..v),
CURVE(FUNCTION(0),BLACK,LINE,p));
end;
Kpoint := proc(d,x,y,n1)
local e,f,t,a,b,h,R,r,j,i,xi,yi,u,v,k;
e:=iquo(d,3); f:=iquo(e,4);
t:=3.; a:=1/t; b:=2/t;
h:=.5; R:=h*t^(1/2); r:=R/t;
x[0]:=1.; x[e]:=-h; x[2*e]:=-h; x[d]:=1.;
y[0]:=0; y[e]:= R; y[2*e]:=-R; y[d]:=0;
to n1 do j := 0;
for i from e by e to d do
xi:=x[j]; yi:=y[j]; u:=x[i]-xi; v:=y[i]-yi;
k:=j+f; x[k]:=xi+a*u; y[k]:=yi+a*v;
k:=k+f; x[k]:=xi+h*u+r*v; y[k]:=yi+h*v-r*u;
k:=k+f; x[k]:=xi+b*u; y[k]:=yi+b*v;
j:=i;
od;
```

```
e:=f; f:=iquo(f,4);
od;
end;
a16 := Koch(6);
```

Mathematica Problem 16:

```
KochSnowflake[n_Integer?NonNegative] :=
Show[Graphics[FixedPoint[
(#1/.Line[{start_,finish_}]
:> doline[start,finish]) &,
{Line[{0,0},{1/2,Sqrt[3]/2}],
Line[{1/2,Sqrt[3]/2},{1,0}],
Line[{1,0},{0,0}]}],
n]],
AspectRatio -> Automatic, PlotRange -> All]
doline[start_,finish_] :=
Module[{vec, normal},
vec = finish - start;
normal = Reverse[vec] {-1,1} Sqrt[3]/6;
{Line[{start, start + vec/3}],
Line[{start + vec/3, start + vec/2 + normal}],
Line[{start + vec/2 + normal, start + 2 vec/3}],
Line[{start + 2 vec/3, finish}]
}
]
KochSnowflake[4]
Reduce has no graphics.
```

17. Write a program to find the Feigenbaum number. This is defined as follows. Consider the function:

$$f(x) = a x(1-x)$$

where a is a parameter. Define $a(n)$ to be the smallest value of a for which f as a map of $[0,1]$ to $[0,1]$ has a cycle of order 2^n . Let $a(\infty)$ be their limit. The Feigenbaum number is $\lim \{a(\infty) - a(n)\} / \{a(\infty) - a(n+1)\}$.

Derive Problem 17: A sixteen line program using *Derive's* IF, ITERATE, and VECTOR functions following the scheme in Gray and Glynn's book on *Mathematica* was provided. Of course, the answer is 4.669...

Maple Problem 17: A roughly 50 line program was provided.

Mathematica Problem 17: A 27 line program was provided. The vendor remarked: "As an exercise, we let this run for some time on a SPARC workstation, and derived the following value for the Feigenbaum Constant:

```
ginf == 3.569945671870944901842004
Feigenbaum constant == 4.669201609103"
```

Reduce Problem 17: An elaborate program of many lines was provided.

18. Write a program to generate a list of all triples of positive integers less than n with the property that the difference between the largest and smallest is not greater than 1/2 the middle one.

Derive Problem 18: Here it is in one line!!

```
F(n):=VECTOR(VECTOR(VECTOR
([k,m,h],m,MAX(k,2*(h-k)),h),k,h,~
MAX(1,h/2),-1),h,n-1)
```

Maple Problem 18:

```
triple :=proc(n)
local i,j,k,c,t;
c := 0;
for i from 3 to n-2 do
for j from i+1 to n-1 do
for k from j+1 to n while 2*(k-i)<=j do
c:=c+1; t[c]:=[i,j,k];
od
od
od;
[seq(t[i],i=1..c)]
end;
```

Mathematica Problem 18:

```
Needs["DiscreteMath`Combinatorica`"]
myTriples[n_Integer?Positive] :=
Select[KSubsets[Range[n - 1],3],
((#[[3]] - #[[1]]) <= #[[2]]/2) &]
allmyTriples[n_] :=
Join[Flatten[Map[Permutations, myTriples[n]],1],
Map[{#, #, #}&, Range[n-1]] ]
```

Reduce Problem 18:

```
procedure gentriple n;
for i1:=1:n-1 join
for i3:=i1:n-1 join
if i3<2*(i3-i1) then {}
else for i2:=max(i1,2*(i3-i1)):i3
join {{i1,i2,i3}};
```

19. Write a program to generate a list of primes between 100,000 and 101,000.

Derive Problem 19: It's two lines of general code:

```
PRIME_COUNT(m,n):=IF(NEXT_PRIME(m)>n,0,1
+PRIME_COUNT(NEXT_PRIME(m),n))
PRIME_LIST(m,n):=ITERATES(NEXT_PRIME(k),k,
NEXT_PRIME(m),PRIME_COUNT(m,n)-1)
PRIME_LIST(100000,101000)
There are 81 primes in the list.
```

Maple Problem 19:

```
plist := proc(a,b)
local p,i,t,j;
p := nextprime(a);
for i do
t[i] := p;
p := nextprime(p);
if p>b then break fi;
od;
[seq(t[j],j=1..i)]
end;
```

Mathematica Problem 19:

```
PrimesBetween[n1_, n2_] :=
Table[Prime[t], {t,PrimePi[n1]
+ 1, PrimePi[n2]}]
PrimesBetween[100000,101000]
```

Reduce Problem 19:

```
for i:=100000:101000 join if primep i then {i} else {};
```

20. Write a program to find the GCD of two polynomials over the field of order 27.

Derive Problem 20: A 26 line program was provided.

Maple Problem 20: A solution was even provided for multivariate polynomials. Here is one for single variable polynomials:

Given a and b in $GF(p^k)[x]$ compute their gcd using the Euclidean Algorithm.

```
GcdUniGFq := proc(a,b,x,p) local c,d,r;
c := Expand(a) mod p;
d := Expand(b) mod p;
while d <> 0 do r := Rem(c,d,x) mod p; c := d; d := r od;
Expand(c/lcoeff(c,x)) mod p # Make the Gcd monic
end;
```

Mathematica Problem 20: A 50 line program was provided.

Reduce Problem 20: No general code for finite fields but there is for modulo arithmetic so it wasn't hard to set everything up although there were more than 50 lines of code. Uses the fact that the field of 27 elements is gotten by adjoining an element of order 3 to Z_3 .

Committee on Human Rights of Mathematicians

Alice T. Schafer, Chair

In the two years since a report from this Committee appeared in the *Notices*, the Committee has considered cases of human rights violations of mathematicians in Russia, Somalia, Tunisia, and the United States. Three of the cases have been settled somewhat satisfactorily but not ideally. The last of the Russian mathematicians on whose behalf the Committee had worked for some time has been allowed to emigrate and is living in this country, but the latest information from him is that he has been unable to locate a position. The Somali mathematician has been freed from prison and allowed to leave the country. (His family had been allowed to leave somewhat earlier.) They are now living in the United States where he has a university position. Unfortunately, the Tunisian mathematician on whose behalf this Committee, as well as other human rights groups, has worked diligently for several years is still in prison under a sentence to run through May 1993. (For a more complete report on this case see the report from this Committee in the July/August 1990 issue of the *Notices*.)

The case in the United States concerned Professor Ethelbert N. Chukwu of North Carolina State University. The Immigration and Naturalization Service (INS) was attempting to deport him on grounds that this Committee, and many other individuals as well, felt were unjustified. The INS eventually brought him to trial and he won. His text, *Stability and Time-Optimal Control of Hereditary Systems*, has just been published (by Academic Press). Professor Chukwu has dedicated that text to "... the good and courageous men and women whose faith in my family sustained us through our recent difficulties ...". Among those mentioned are some members of this Committee and William Browder, AMS President at the time of Professor Chukwu's trial.

In addition to its efforts on behalf of the mathematicians in the above cases, some members of the Committee felt that the AMS Council should be asked to submit to the Israeli authorities a resolution on behalf of the mathematicians and mathematics students at the universities and colleges in the West Bank and Gaza, which had been closed from time to time. The resolution would urge the Israeli Government and all parties to work together to keep the universities and

colleges open. A resolution was submitted to the Council at its meeting in Orono in August 1991. That resolution was tabled. A second resolution was submitted to the Council for consideration at its meeting in Baltimore in January 1992. That resolution was defeated by a vote of 12 to 11.* At the time of the writing of this report, the Israeli Embassy in Washington reports that all universities and colleges in the West Bank and Gaza are open.

Richard Dicker, Director of the New York based Committee to End the Chinese Gulag, met with this Committee at the Joint Mathematics Meetings in Baltimore in January 1992. The Committee to End the Chinese Gulag was formed in 1991 and numbers among its members the astrophysicist Fang Lizhi and the physicist Yuri Orlov. The Committee has written a pamphlet giving suggestions for actions that scientists might take when they attend scientific conferences in China. (For additional information, the Committee may be contacted at 485 Fifth Avenue, New York, NY 10017.)

The Committee wishes to express its appreciation to the following groups for sharing information on human rights violations of individual mathematicians: Committee of Concerned Scientists (New York), the Human Rights Committees of the American Association for the Advancement of Science (AAAS) and of the National Academy of Sciences, and the Chicago Action for Soviet Jewry. I would like to thank personally those members who have retired from the Committee in the last two years for their invaluable contributions to the work of the Committee: Raymond Ayoub, Joan S. Birman, Michael I. Brin, Chandler Davis, and Joel L. Lebowitz.

*The resolution presented at the Baltimore meeting read as follows: "The Council of the AMS takes note of the historical fact that the universities in the West Bank and Gaza came into existence after the 1967 war under Israeli occupation as a result of the initiatives taken by residents of the territories. These initiatives had been ignored by former regimes there. The Council, with this history in mind, deplors the frequent closings of the colleges and universities in the territories. These closings have hurt students and faculty in all fields, including mathematics, and impaired their ability to carry out normal educational activities."

"The Council notes that Birzeit and Al-Najah Universities have been closed for over three years and that the other colleges and universities have been closed for shorter periods of time. It is pleased to note that all of these institutions, with the exception of Birzeit University, have recently been reopened. The Council calls upon the Government of Israel to reopen Birzeit University. The Council asks all sides to work actively to restore conditions which would permit maintaining normal educational and research activities of the colleges and universities."

Washington Outlook

This month's column is written by Lisa A. Thompson, who is the Assistant for Governmental Affairs of the Joint Policy Board for Mathematics (JPBM).

Once an intriguing albeit academic topic for science policy observers, discussion of how the government allocates resources among the various elements of the scientific enterprise—that is, how it sets priorities—has received more attention from the science policy establishment, including Congress, in the past few years.

The issue is not straightforward, because the R&D budget is necessarily disaggregated in different ways at different stages of the complex federal budget process, but Congress is increasingly concerned that funding decisions need to be made more rationally. Several scientific groups, too, have formulated goals and priorities to guide federal support for their particular areas.

The severity of the federal budget crisis (discussed in previous Washington outlook columns) is one reason improvements in the science budget-making process are so important. Moreover, the political climate of the last decade raised new demands that government be accountable to voters and taxpayers.

Because Congress is not well equipped to determine the scientific merit of R&D proposals, it relies on advice from the science community to sort out the diverse claims on the R&D budget. What many see as a lack of priority-setting by the science community has led to some accusations that it is an insatiable constituency that regards all of its proposals as essential.

The issue is often highlighted—and muddled—by immediate policy concerns, the most controversial of which are “big science” projects like the space station and the Superconducting Supercollider. While the high energy physicists might regard the latter project as crucial to the advancement of high energy physics, and the Office of Energy Research (with advice from scientific panels) decides where the project fits into its goals and budget plan, Congress, facing an up or down vote, will always weigh the project in light of other national needs, including deficit reduction.

Furthermore, the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET) and the ini-

tiatives it coordinates have added a new layer to the budget-making process. The “top-down” priorities imposed on basic research by FCCSET need to be reconciled with the “bottom-up” priorities coming from the scientific community.

Research and Development in the Federal Budget Process

The executive branch's prioritization of federal science programs is implicit in its annual budget submissions, in which R&D is highly compartmentalized. The numerous agencies responsible for research set their budgets independently according to their own missions and goals. While the Office of Management and Budget (OMB), in consultation with the Office of Science and Technology Policy (OSTP) approves agency science budgets with broad Administration goals in mind, this cannot be construed as a prioritization of the overall R&D budget.

In fact, federal R&D cannot be prioritized as a bloc since most of it is done for purposes that transcend science—e.g., national defense and public health. Federal Science programs compete within these areas among not only other science programs but other spending as well. Because questions relating to allocation of funds among these and other national needs and public goods belong to the realm of politics, the political process will always be the final arbiter of the trade-offs among competing public needs and, therefore, of the broad structure of the science budget.

In this context, Congress influences the structure of the science budget only at the margins. In responding to the President's spending proposals, it divides the budget into trade-off areas in different ways for each of the three different stages of the budget process (budget, authorization, and appropriation). While it can assign different relative values to defense and domestic spending, and thus influence the research budget at broad levels, it is logistically difficult to impose an alternative priority scheme on the overall science budget or to directly transfer funds from, say, the space station to AIDS research.

Improving the Science Policy Process

There is a need to consider the science budget as a whole, however, especially since sustaining the U.S. scientific enterprise is an important national goal in itself. The House

Committee on Science, Space, and Technology (HSST), as one of the few mechanisms that could conceivably approach assessment of the federal research enterprise, has made the most progress in addressing science priorities. (The House Budget Committee has also taken up the matter, although in the context of the big science vs. little science debate; also, a few Members of Congress are trying to establish a bipartisan, bicameral Science and Technology Study Conference, which might also choose to look at science priorities.)

At the request of the committee, the Office of Technology Assessment (OTA) last year released a comprehensive report, "Federally Funded Research: Decisions for a Decade," outlining the major issues involved in priority-setting for science. The thrust of the report is that there will always be more good ideas from the scientific community than there is federal money to support them, and therefore, the government needs to set priorities to guide funding decisions. The report then defines some of the issues arising from the installation of a more rational priority-setting process.

In response to the OTA report, the staff of HSST organized a task force to reexamine the assumptions and conventional wisdom of federal science policy and the criteria used in allocating resources among the elements of the scientific enterprise. A report from this task force is expected imminently, and it will likely focus on how the government might go about setting science policy goals, formulate criteria used to determine which research ought to be funded, and measure progress toward those goals. (See the February 1992 issue of the *Notices* for a more thorough explanation of this exercise and the contributions of the mathematical sciences community.)

The objective of this exercise is to allow the committee to carry out its authorization responsibilities more systematically and, hopefully, to facilitate optimal decisions. While HSST is charged with determining appropriate funding levels for and setting priorities within the budgets of the agencies under its jurisdiction (the National Science Foundation, NASA, the National Institute for Standards and Technology, and other programs at the Department of Commerce, Department of Energy research programs, and Environmental Protection Agency research programs), it has no methodical procedure to make these decisions.

Concurrently, the committee's subcommittee on science is holding a series of hearings to examine how priorities are set among research programs of different agencies and programs within those agency budgets and how those priorities are conveyed to Congress. The frustration of the subcommittee clearly stems from the fact that the Administration's science priorities are rarely made explicit, despite the recent emergence of cross-agency research programs.

Witnesses at these hearings generally concur that a more rational process for determining science budgets is desirable. Here, too, it was made clear that well-defined goals have to be established before priorities can be invested with meaning. The subcommittee appears to be leaning toward assigning specific responsibility for establishing priorities to some executive branch entity; an upgraded FCCSET is a likely candidate.

Several witnesses emphasized the importance of involving the scientific community in assessing relative merits of federal science programs, some suggesting an iterative process would be necessary.

Agencies Plan for Leaner Times

The federal research agencies are mindful of Congressional frustration with the unending demands on the federal science budget. Coupled with expectations of flat or even declining budgets, several agencies have tackled, or will soon tackle, the process of setting explicit criteria for making choices among competing scientific programs and projects. At the same time, the agencies are in search of new ways to justify growing research budgets in a tight fiscal climate.

In particular, the National Science Foundation (NSF) and the National Institutes for Health (NIH) are responding to new demands on their agencies with strategic goals and plans. NIH Director Bernadine Healy, who is fond of saying, "This is not your father's NIH," is dragging the biomedical community through a strategic planning process to frame the agency's budget in terms of national goals rather than numbers of research grants.

NSF Director Walter Massey, too, is developing a strategic plan for his agency. Massey intends that the result of the strategic planning process will be an agreement with the Administration and Congress for continued NSF budget growth. As does Healy, Massey realizes that NSF cannot keep doing business as usual. It must be a responsible, accountable steward of public funds. It must coordinate its programs with those of other entities (e.g., states, other federal agencies, colleges and universities) and must be responsive to overall federal R&D priorities associated with important national goals, including those initiated by Congress. Specific justifications are necessary for budget increases even in basic research, where level-of-effort, as opposed to goal-driven, programs predominate and the primary criteria for funding decisions is scientific excellence.

Setting Goals and Priorities for Scientific Disciplines

At the agency program level, the scientific disciplinary communities contribute greatly to the implementation of priorities for programs associated with their respective discipline. But these programs increasingly have to be reconciled with the broad directives of federal R&D, as well as those of the agency budget. Reconciling "bottom-up" goals and priorities coming from the scientific community with the "top-down" goals and priorities of (in most cases) several agencies that sponsor disciplinary research is an even greater challenge, and leaves many feeling that science budgets are less than optimal.

The science subcommittee hearings also showcased several disciplinary scientific organizations that have undertaken bottom-up goal- and priority-setting exercises for their particular areas of science. It was noted that such statements seem to be faring well in the political process; after all, consensus

is politically compelling. At the same time, it is not necessarily a simple matter to gain the acceptance of the affected agencies and Congress for a discipline's self-selected goals. Acceptance of goals is often a function of advocacy even when the political process relies on the scientific community to establish funding criteria.

The astronomers, through an iterative consensus-building process, put together a plan that prioritizes astronomy research and derives from that a ranking of proposed facilities. Space scientists are in the process of a similar exercise. The ecologists recently developed and are promoting a "sustainable biosphere initiative"; the goals for basic ecological science are

linked with important socio-environmental goals, a powerful combination. The jury is still out as to whether these efforts will succeed at both of their underlying objectives: more influence for the discipline over federal funding decisions with regard to the discipline, and a higher priority for the discipline relative to other elements of federal research.

While declining research budgets pose a serious threat for the mathematical sciences community, the new emphasis on science priorities provides a challenge and an opportunity to think about how the federal government approaches support for the mathematical sciences and perhaps obtain more support for the legitimate needs of the discipline.



American Mathematical Society TRANSLATIONS

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Algebra and Analysis

A. D. Aleksandrov,
O. V. Belegadek, I. A. Bokut',
and Yu. L. Ershov, *Editors*

This collection consists of lectures delivered at the First Siberian Winter School, "Algebra and Analysis," held in March 1987 at a retreat near Kemerovo. The school was organized by Kemerovo State University and the Institute of Mathematics of the Siberian Branch of the Academy of Sciences of the USSR. The conference drew more than 100 participants from Novosibirsk, Kemerovo, Omsk, Moscow, St. Petersburg, and other cities. The papers concern current research on the interface of algebra and analysis.

1991 *Mathematics Subject Classification*: 05, 14, 15, 16, 17, 22, 28, 34, 51, 53, ISBN 0-8218-3700-1, 112 pages (hardcover), February 1991, **Indiv. mem. \$38**, List \$63, Inst. mem. \$50
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S. G. Gindikin, *Editor*

This volume focuses on the spectral theory of differential operators. The emphasis is on estimates of the number of negative

eigenvalues of elliptic differential operators and on the analysis of asymptotical distribution of eigenvalues. This collection provides an excellent overview of problems in the field, for Gindikin ranks among the leading Soviet specialists in this area of research.

1991 *Mathematics Subject Classification*: 34, 47; 58, ISBN 0-8218-7500-0, 176 pages (hardcover), March 1992
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News and Announcements

Richard S. Pierce 1927–1992

Richard Scott Pierce, former AMS associate secretary, died on March 15, 1992. Born on February 26, 1927, he received his B.S. in 1950 and his Ph.D. in 1952, both from the California Institute of Technology. He was a Fellow of the Office of Naval Research at Yale University (1952–1953) and a Jewett Research Fellow at Harvard University (1953–1955). He was at the University of Washington until 1970, when he went to the University of Hawaii. In 1975, he joined the faculty at the University of Arizona, where he remained until his death. His mathematical areas were lattice and ring theory, Boolean algebras, and abelian groups.

In addition to serving as associate secretary of the AMS from 1960 to 1971, Professor Pierce served on a number of Society committees, including the *Mathematical Reviews* Editorial Committee (1968–1973) and the Publications Committee (1968–1970). He was an ex-officio member of the Council from 1960 to 1969.

Prizes of the Parisian Academy

The Académie des Sciences de Paris has announced a number of prizes and awards presented to researchers in the mathematical sciences.

The golden medal “Henri Poincaré” for 1992 has been awarded to JOHN THOMPSON of Cambridge University. This medal has been awarded only on exceptional occasions. The previous two recipients were Jacques Hadamard in 1962 and Pierre Deligne in 1974. Thompson received the medal for his de-

cisive contributions to the development of the theory of finite groups during the past thirty years.

The Ampère Prize of 200,000FF has been awarded to PIERRE-LOUIS LIONS of the University of Paris–Dauphine. This prize is given every year, alternately in mathematics and physics. Lions is honored for his major contributions to the study of nonlinear partial differential equations arising in stochastic analysis, continuum mechanics, and mathematical physics. His Ph.D. thesis, under the direction of Haïm Brezis, was concerned with the Hamilton-Jacobi-Bellman equation, which he solved using a combination of partial differential equation and probabilistic techniques. Later, he introduced with Michael Crandall the notion of “viscosity solutions”, which has now become a classical tool. In 1987, Lions and Ronald DiPerna presented the first general existence result of global weak solutions for the Boltzmann equation, using an approach that applies to many models of gas dynamics. Lions is also the inventor of the “concentration-compactness” method which aids the understanding of all possible singular behaviors of sequences in problems which lack compactness; this method has numerous applications, from differential geometry to fluid mechanics.

The Prix de l’Etat of 50,000FF was presented to GILLES PISIER of the University of Paris VI. Awarded every year, this prize rotates among all areas of science. Pisier is a leading expert in the geometry of Banach spaces. Strongly influenced by Laurent Schwartz, he has combined in a very ingenious manner the geometry of Banach spaces with proba-

bility techniques. His first works, partly in collaboration with Bernard Maurey, concerned the notion of “type” and “cotype” of Banach spaces. In particular, using martingales, Pisier has studied the type and cotype of uniformly convex spaces. He has solved several conjectures of Grothendieck concerning tensor products of Banach spaces and nuclear operators. In addition, he has made important contributions to random Fourier series and harmonic analysis. His book, *Volume Inequalities in the Geometry of Banach Spaces*, was published by Cambridge University Press in 1989.

There were several other prizes awarded by the Académie. GILLES LEBEAU of the University of Paris-Sud received the Servant Prize (10,000FF) for his work on the propagation of singularities and controllability. GÉRARD LAUMON of Centre National des Recherches Scientifiques (CNRS) in Orsay received the E. Dechelle Prize (10,000FF) for his work on the geometric Fourier transform and automorphic forms. BENOÎT PERTHAME of the University of Orléans received the Blaise Pascal Prize (10,000FF) for his work on Boltzmann schemes. CLAUDE BARDOS of the University of Paris VII received the E. Brun Prize (10,000FF) for his work on gas dynamics and its applications to reentry problems. JEAN-JACQUES RISLER of the University of Paris VI received the C. L. de Saulses de Freycinet Prize (8000FF) for his work on real algebraic geometry and differential analysis. ETIENNE PARDOUX of the University of Provence at Marseille received the Montyon Prize (6000FF) for his work on stochastic analysis. FRANÇOIS LEDRAPPIER of CNRS at Paris VI received the

Carrière Prize (4500FF) for his work on ergodic theory. DANIEL LEHMANN of the University of Toulouse received the V. Thébault Prize (4500FF) for his original book, *Initiation to Geometry*. GEORGES SKANDALIS of the University of Paris VII received the Francoeur Prize (4500FF) for his work on the K-theory of C^* -algebras and Kasparov's theory. PIERRE GRISVARD of the University of Nice and Institut Henri Poincaré received the P. D. Emile Blutet Prize (4000FF) for his work on elliptic equations in irregular domains. JEAN-MICHEL GHIDAGLIA of the Université de Paris-Sud at Orsay and Ecole Normale Supérieure de Cachan received the d'Aumale Prize (3000FF) for his work on attractors of some nonlinear evolution problems.

The Parisian Academy also elected a number of foreign members. LENNART CARLSON of the University of Uppsala and the University of California at Los Angeles and JOHN T. TATE of the University of Texas at Austin were elected in Mathematics, and T. BROOKE BENJAMIN of Oxford University was elected in Mechanics.

1992 d'Alembert Prize Awarded

The Société Mathématique de France has announced two winners of the d'Alembert Prize for 1992. Presented every two years, the prize recognizes outstanding books, articles, radio or television broadcasts, films, or other projects that promote public awareness of recent developments in mathematics. This year, the prize amount is 20,000FF.

IVAR EKELAND received the prize for the book *Au Hasard: La Chance, La Science, Le Monde (At Random: Chance, Science, and the World)*, published by Le Seuil. Ekeland is currently president of Paris Dauphine University. The citation for the prize says that Ekeland explains, in a clear, simple, and imaginative way, the great mathematical notions connected to chaos and their applications to physics and economics. This well-written book, says the citation, "is a dialectical fresco on order and disorder, determinism in indeterminism, and indeterminism in determinism." The book discusses randomness, entropy, unpredictability, game theory, attractors,

catastrophe theory, and the use of statistics in these areas. The citation ends by noting, "this book is not only one by a mathematician, but one by a humanist and a writer. It is a book that makes one understand and makes one reflect."

The other winner is the project "Math en jeans". The idea of "Math en jeans" is to associate two secondary school mathematics classes with a research project, under the guidance of a teacher and a mathematician. The students (not necessarily those at the top of their class in mathematics) devote two hours per week to learning about such subjects as secret codes, non-Euclidean geometry, or the golden mean. The group defines and explores various questions that arise, and the presentation of "seminars" allows for many fruitful exchanges. The citation notes, "This liberal and open approach to mathematics has encountered unprecedented success among the students, to whom it offers the possibility to create in a domain that had previously seemed cold and inaccessible. The jury of the d'Alembert prize could certainly not remain insensitive to the spirit of 'Math en jeans' which seems to them to be one of the best ways to bring to young people a new vision of mathematics."

The d'Alembert prize was presented by Professor Hubert Curien, French Minister of Research and Space, during a reception held at the Ministry on May 15, 1992, at the conclusion of a gathering organized jointly by the Société Mathématique de France and the Société Mathématiques Appliquées et Industrielles. Under the title, "Mathématiques au Futur," this meeting announced to the press the launching of the World Mathematical Year 2000 as decided by the Executive Committee of the International Mathematical Union at its May 6 meeting in Rio de Janeiro.

AWM Announces Schafer Prize Winner

Zvezdelina E. Stankova of Bryn Mawr College has been named the recipient of the third annual Alice T. Schafer Prize, sponsored by the Association for Women in Mathematics (AWM). The prize, given to an undergraduate woman in recognition of excellence in math-

ematics, carries a \$1000 stipend. The prize committee also named Julie B. Kerr of Washington State University as Runner-Up and selected nine other nominees for Honorable Mention. The awards were presented at the annual meeting of the Society for Industrial and Applied Mathematics in Los Angeles in July.

The prize is named in honor of Alice T. Schafer of Marymount University, a former president and a founding member of AWM who has taken a special interest in supporting women at the start of their mathematics careers. The 1992 prize committee consisted of Schafer, Jill P. Mesirov of Thinking Machines Corporation, and Ann K. Stehney of the Center for Communications Research.

The committee noted that the field of thirty-two candidates seemed especially strong. In addition to their impressive achievements in coursework, independent study, competitions, and undergraduate research programs, the nominees devoted themselves to numerous projects on behalf of the mathematical life of undergraduates at their institutions.



Zvezdelina E. Stankova

ZVEZDELINA E. STANKOVA, a 1992 graduate of Bryn Mawr College, has earned wide recognition for her work and her performance in mathematical competitions. She participated last summer in the Research Experiences for

Undergraduates program at the University of Minnesota at Duluth, where her research on classifying permutations with forbidden subsequences of length four was praised as impressive work on a difficult problem. She presented her results at the Joint Mathematics Meetings in Baltimore in January 1992. In nominating Stankova, Rhonda Hughes of Bryn Mawr wrote, "Her results are strikingly original and one is always reminded that her work is that of an extraordinary mathematician." A two-time silver medalist on the International Mathematics Olympiad team from her native Bulgaria, Stankova's talents as a problem-solver and an expositor earned her the distinction of Runner-Up for the Schafer Prize last year. She returned to the Duluth program this summer before beginning graduate work in mathematics this fall at Harvard University.



Julie B. Kerr

JULIE B. KERR, Runner-Up for this year's Schafer Prize, will graduate in December from Washington State University. She received Special Recognition from the 1990 Schafer Prize committee for her early achievements, including distinction in graduate courses as a first-year student. In each of the last two years, she finished in the top sixty students on the Putnam Examination for undergraduates. Following a Budapest Semester in Mathematics as a sophomore, Kerr participated in the 1991 NSF-

sponsored Mills Summer Mathematics Institute, and this summer she worked in computational number theory at the Research Experiences for Undergraduates program at the Rose-Hulman Institute of Technology. An aspiring teacher, Kerr also finds time to tutor in mathematics.

The following outstanding women students received Honorable Mention: MARCIA JOYCE GEIGER ISAKSON, U.S. Military Academy; CHERYL P. GROOM, University of Michigan; KRISTINE HAUSER, Grinnell College; LAURA HEGGERLE, Colorado College; EUGENIE HUNSICKER, Haverford College; MARY C. JOYCE, University of Massachusetts at Amherst; MARTHA J. MANCEWICZ, Kalamazoo College; JENNIFER WILLIAMS, Oklahoma State University; and VIRGINIA E. WRIGHT, Emory University.

MacArthur Fellowships Awarded

Three members of the mathematical sciences community have received MacArthur Fellowships in this year's round of awards. The fellowships range in size from \$150,000 to \$375,000 over five years, depending on the age of the recipients. There are no strings attached, and fellows may use the funds in any way they please. Individuals cannot apply for MacArthur Fellowships. Candidates are nominated by a group of one hundred designated nominators, and awardees are chosen by a twelve-member selection committee which meets eight times a year.

INGRID DAUBECHIES, professor of mathematics at Rutgers University, received a \$240,000 grant over five years. Daubechies specializes in wavelet theory, a new form of Fourier analysis that may revolutionize the manipulation and storage of data, including voice and image signal analysis, and data compression. In addition, wavelet theory is finding applications in numerical analysis, operator theory, harmonic analysis, and the study of turbulence. Daubechies has also worked on Weyl quantization, continuous-time regularization of coherent state path integrals, and the extension of mathematical models for the stability of matter to include relativistic kinematic effects. She earned her bachelor's degree (1975) and doctorate (1980) in physics at the Free University in Brus-

sels. Daubechies is organizing an AMS Short Course on Wavelets and Applications, to be held January 11-12, 1993, in conjunction with the Joint Mathematics Meetings in San Antonio.

JOHN HOLLAND, professor of psychology at the University of Michigan and a fellow at the Santa Fe Institute, received a \$369,000 grant over five years. In the early 1970s, Holland created the genetic algorithm, a general computational algorithm that can be used to discover better solutions to problems by recombining and mutating previous solutions. In the 1980s, he began to investigate how learning systems generalize, make inductions, and form internal representations of their environments. By studying how biological systems adapt and improve, Holland was able to create classifier systems, which are sets of interacting condition/action rules. With the tool of classifier systems, he solved two practical problems in artificial intelligence: how to design procedures that can learn appropriate behavior rather than have the behavior programmed in; and how to test new behaviors while avoiding system breakdown. He is also beginning to apply his ideas on nonlinear adaptive systems to economics. Holland received his B.S. in physics from the Massachusetts Institute of Technology (1950), his M.A. in mathematics from the University of Michigan (1954), and the first Ph.D. in computer science (at that time called communications sciences) awarded by Michigan (1959).

URI TREISMAN, professor of mathematics at the University of Texas at Austin and director of the Dana Center for Mathematics Education at the University of California at Berkeley, received a \$285,000 grant over five years. Treisman works on improving mathematics instruction in high schools and colleges, with an emphasis on ethnic minority students. His research and its applications have led to a dramatic increase in the retention and graduation of minority students. He started the Mathematics Workshop Program at Berkeley in 1978, which reduced to as little as 4% the failure rate in calculus of participating minority students. Adaptations of the workshop have been successfully

used at institutions across the country. He directed an equally influential attempt to alter the freshman year program in calculus and precalculus. He is currently working to assemble a consortium of 200 institutions of higher education to encourage greater representation of minority students in mathematics and related fields. He advocates systemic changes at all levels of educational policy.

Minority Scholars Receive Fellowship

The National Research Council has made one hundred awards in two Ford Foundation programs to support minority scholars. The first program supports graduate students, through Predoctoral Fellowships that provide funds for stipends and tuition for three years of tenure, and through Dissertation Fellowships that provide a nine- or twelve-month stipend. The second program provides Postdoctoral Fellowships to allow doctoral recipients to pursue research.

Among this year's recipients are two in the mathematical sciences: F. DuBOIS BOWMAN of Duke University, who works in statistics, and PABLO A. PEREZ of the University of California at Los Angeles, who works in applied mathematics. Each received a Predoctoral Fellowship.

Plans for the 1993 fellowship competitions are now under way. For information and application materials, write to: Fellowship Office, National Research Council, 2101 Constitution Avenue, NW, Washington, DC 20418.

Babbitt Named Executive Editor of *MR*

Donald G. Babbitt of the University of California at Los Angeles has been named executive editor of *Mathematical Reviews*. He succeeds Gerald J. Janusz, who served in the post for two years and has now returned to the University of Illinois at Urbana-Champaign.

Babbitt received his Ph.D. from the University of Michigan in 1962 and works in mathematical physics and differential equations in the complex domain. He has been at UCLA since 1962 and has held visiting positions at a

number of institutions, including Indiana University (1966), the Institute for Advanced Study in Princeton (1970–1971), and the University of Virginia (Fall 1975). He has been on a number of administrative committees at UCLA and also served as associate dean of the Graduate Division.



Donald G. Babbitt

"These are very challenging times in the production and delivery of mathematical databases," says Babbitt. Some of the challenges for *MR* are the ever-increasing number of mathematical publications, calling for more sophisticated search strategies for the database; space limitations of libraries; keeping *MR* useful and responsive to the needs of mathematicians; and controlling the costs of producing and delivering the *MR* database. These challenges portend changes in *MR*, Babbitt explains. "For example, many experts feel that most database publications such as *MR* will become purely electronic in the relatively near future," he notes. "In another direction, some have suggested that the *MR* database itself should be changed so that, for example, 'seminal' papers would receive in-depth special reviews. These papers might be selected by a special editorial body (this, of course, is a tricky issue!) and the review itself would be expected to include the historical context of the main results . . . There were many reviews like this in the old

days, but my impression now is that they are rare.

"These are some of the challenges which need to be addressed in the next few years at *MR*, and this is why I am excited about my new job as executive editor. I am well aware that all of the challenges must be addressed with the advice and help of the excellent *MR* staff, the *MR* Editorial Committee, and the mathematics community at large."

Steen Heads MSEB

Lynn Arthur Steen of St. Olaf College has taken the position of executive director of the Mathematical Sciences Education Board (MSEB) of the National Research Council (NRC). He succeeds Ray Shiflett, who has returned to his faculty position at California State Polytechnic University at Pomona.

Steen, well known for his influential writings and his advocacy for mathematics education, has had close ties with the MSEB since the Board was established in 1985. He was a member of the original Conference Board of the Mathematical Sciences committee that proposed the formation of a national board on mathematics education, and he was a charter member of MSEB until June 1991. Steen has worked on a number of MSEB publications: he wrote *Everybody Counts* and edited *Reshaping School Mathematics*, *On the Shoulders of Giants*, and *Moving Beyond Myths*. In addition, he worked last year on a joint effort of MSEB and the Mathematical Association of America to begin MSEB outreach to the higher education community.

"MSEB will continue to stress policy studies in areas of importance to the mathematics education reform movement," says Steen. "Our emphasis at the moment is on assessment—to help the nation learn to measure what's important in ways that improve children's learning." In addition, he notes, MSEB is beginning to increase emphasis on minority students and higher education. Two new program directors, J. Arthur Jones and Susan Forman, are in place to head these activities, and task forces have been established.

MSEB will also be tying into an NRC effort, begun this summer, to produce the

nation's first statement of standards for school science. "There will be many opportunities for cooperation and creative curricular linkages that emerge as the science standards join the [National Council of Teachers of Mathematics] mathematics standards as statements of national expectations for our schools," Steen remarks.

"I am excited by the challenge of MSEB, especially at this particular time of new opportunity to make learning effective for all students, to cooperate on science standards, and to move beyond myths in higher education," Steen declares. "MSEB has broken new ground for national leadership within the American tradition of decentralized education and helped create a momentum for change that now has many partners. It is a good time to improve mathematics education, and I feel fortunate to have the opportunity to make a contribution."

NAS President and Foreign Secretary

Send Letter to I.R. Shafarevich

On July 28, 1992, the National Academy of Sciences (NAS) sent out in a press release the following letter to I. R. Shafarevich of the Steklov Institute in Moscow:

"We are writing to you, a distinguished foreign member of our Academy, by unanimous decision of the Council of the National Academy of Sciences to express our strong aversion to your anti-Semitic writings as contained in *Russophobia*, a translation of which has been made available to us.

"Moreover, we are informed that there are few, if any, Jewish members of the Steklov Institute in Moscow, even though many of the outstanding mathematicians of Russia are Jewish. It is difficult to avoid the conclusion that the discriminatory practices of the well known anti-Semitic former director persist under present leadership.

"The National Academy of Sciences, as an institution, holds deeply to the principle that discrimination against individuals for reasons of race, sex, or religious beliefs is intolerable. Using your position to speak against Jews because of your perception of their influence upon Russian society is not only

deplorable, but violates the principles of our Academy.

"If *Russophobia* represents an accurate expression of your views, and if our information of the composition of the algebra section is a reflection of your influence on hiring and appointment practices, you may wish to consider whether it is appropriate for you to maintain your membership in the National Academy of Sciences."

The letter is signed by Frank Press, President, and James B. Wyngaarden, Foreign Secretary, of the NAS.

The press release from the NAS said that this is the first time in the Academy's history that such a letter has been sent to one of its members. Shafarevich has been at the center of a controversy in the international mathematical community because of *Russophobia*. In particular, an open letter to Shafarevich, carrying about 425 signatures, was published in the March 1992 issue of the *Notices*.

Mathematics Advisory Committee to Meet

The Advisory Committee for the Mathematical Sciences for the National Science Foundation (NSF) will meet October 26–28, 1992, at NSF headquarters in Washington, DC.

The Committee provides advice on NSF policy as it relates to the mathematical sciences. The last meeting of the Committee touched on concerns raised within the mathematical sciences community about the Foundation's budget request for fiscal year 1993. In addition, there was a serious discussion of the idea of revamping the structure of mathematics grants so that grant amounts are based on a tiered, flat-rate system, rather than on principal investigator salary.

The upcoming meeting is likely to center on these and other important issues facing the community. In addition, a new director of the Division of Mathematical Sciences (the successor of Judith Sunley, who is now executive officer of NSF's Directorate of Mathematical and Physical Sciences) will probably have been chosen by the time of the meeting, making for interesting and lively discussions about the future of the Division.

Most of the meeting will be open to the public. Those interested in attending should contact Trudy Sensibaugh in the Division of Mathematical Sciences: telephone 202-357-9669; tsensiba@nsf.gov (Internet) or tsensiba@nsf.gov (Bitnet).

News from the Mathematical Sciences Research Institute

Berkeley, California

This fall, William Thurston will assume the Directorship of the Mathematical Sciences Research Institute (MSRI) upon the retirement of Irving Kaplansky. Robert Osserman will continue to serve half-time as Deputy Director and will be joined by Lenore Blum who will also serve as half-time Deputy Director.

Three programs are planned for 1992–1993: a full-year program in Algebraic Geometry, a half-year program in the Fall in Symbolic Dynamics, and a half-year program in the Spring on Transcendence and Diophantine Problems.

The following workshops are scheduled for 1992–1993:

September 21–23, 1992, Workshop on Algebraic Cycles, Organizers: A. Beilinson and W. Fulton; October 12–16, 1992, Workshop on Visualization of Geometric Structures, Committee: F. Almgren, D. Hoffman, D. Lind, and A. Marden (chairman); November 2–6, 1992, Workshop on Symbolic Dynamics, Committee: M. Boyle (chairman), J. Wagoner, and S. Williams; November 16–18, 1992, Workshop on Higher Dimensional Complex Geometry, Organizers: J. Kollar and S. Mori; December 2–4, 1992, Workshop on Curves, Abelian Varieties, and their Moduli, Organizers: A. Arbarello, A. Beauville, and J. Harris; March 29–April 2, 1993, Workshop on Diophantine Geometry, Organizer: P. Vojta; and July 12–23, 1993, Conference on Universal Algebra and Category Theory, Committee: F. Linton, S. Mac Lane (cochairman), R. McKenzie (cochairman), G. McNulty, W. Taylor, and C. Wells.

The algebraic geometry program will be organized around monthly themes as follows:

September: Algebraic Cycles (Contacts: A. Beilinson, W. Fulton); October:

Vector Bundles (Contact: R. Lazarsfeld); November: Higher Dimensional Geometry (Contacts: J. Kollar, S. Mori); December: Curves, Abelian Varieties, and their Moduli (Contacts: A. Beauville, J. Harris); January: Surface Theory, Classical Projective Geometry (Contacts: R. Friedman, J. Harris); February: Topology of Moduli Spaces (Contact: E. Arbarello); March: Enumerative and Computational Algebraic Geometry (Contact: W. Fulton); March: Crystalline Methods and Hodge Theory (Contacts: A. Beilinson, A. Ogus); April: (Open); and May: Singularity Theory and Hodge Theory (Contacts: M. Green, J. Steenbrink).

1993–1994 will feature a jumbo program in Differential Geometry lasting the full year, and a half-year program in Dynamical Systems and Probabilistic Methods for PDE's in the Spring: January - June, possibly extending through July. Note that the latter program was referred to as "Coherent Structures" in preliminary announcements and also in the application forms for 1993–1994.

The Differential Geometry program has been organized around a number of themes, running during overlapping periods. The final schedule has not yet been set, but the following is a tentative plan, including members of the organizing committee associated with certain of the themes.

1. Mathematical Physics and Geometry (Bott). This is the main subprogram outside of pure geometry and, in principle, it should run all year. High activity period: January 1994, with a workshop including some other areas, for example: low-dimensional geometry, moduli of Einstein spaces, elliptic genera, etc. Other periods of activity: February and periods in the Fall.

2. Nonlinear Analysis and Geometry (Schoen). Harmonic maps, minimal surfaces, Einstein spaces, scalar curvature, etc. This theme is emphasized in the Fall and late Spring. High activity period: September 1993.

3. Rauch-Gromov Theory (Grove). Positive curvature, convergence and collapse of metrics, finiteness theorems, filling manifolds, Alexandrov spaces and singular metrics, etc. This theme is emphasized in the Fall. High activity period:

riod: September – October 1993 with a workshop.

4. Hyperbolic Geometry (Ballmann). Negative curvature, rigidity, geodesic flows, hyperbolic groups, etc. This program is emphasized in the Fall. High activity period: October 1993.

5. Spectral Geometry (Gordon). Isospectral deformations, eigenvalue problems, eta invariants, etc. High activity period: November 1993. Secondary activity period: Spring 1994.

6. Exterior Differential Systems (Bryant). Geometric structures, characteristic classes of systems, control theory, etc. This program is emphasized in the Fall. High activity period: December 1993.

7. Low Dimensional Geometry. Geometry of 3- and 4-manifolds, gauge field theory, monopoles, gravity in 2 + 1 dimensions, twistor theory, etc. High activity period: February 1994.

8. Arakelov Theory. High activity period: Possibly November or March.

9. Ricci Curvature Questions. Einstein spaces and their moduli, spaces of positive/negative Ricci curvature. High activity period: Sometime in Fall or in late Spring.

For more information, write to MSRI at 1000 Centennial Drive, Berkeley, CA 94720. Program information and documents, including application forms are also available on-line by sending email to info@msri.org, consisting of the message "index".

Note: The Fields Institute in Waterloo, Canada, has scheduled a micro-program in Riemannian geometry for August 1993, in coordination with the MSRI 1993–1994 program in Differential Geometry. Details of the program will be announced shortly.

News from the Institute for Mathematics and its Applications University of Minnesota

The Institute for Mathematics and its Applications (IMA) 1992–1993 academic year program **Control Theory and its Applications** is now underway, led by program coordinators H.J. Sussmann (Chairman), W.H. Fleming, P.P. Khargonekar, P.R. Kumar, D.L. Russell, and S.E. Shreve. The year is divided into

three parts (corresponding to fall, winter, and spring quarters) although it is expected that there will be considerable fluidity between the various parts.

(1) Fall: September 8–December 30, 1992, Linear and distributed parameter systems

(2) Winter: January 2–March 30, 1993, Nonlinear systems and optimal control

(3) Spring: April 1–June 30, 1993, Stochastic and adaptive systems

The fall program was described in the July/August 1992 *Notices*. Here we provide some details about the winter program.

On January 25–29, 1993 there will be a workshop on **Robotics** organized by J. Baillieul, S. Sastry, and H.J. Sussmann. This workshop will feature a mathematical introduction to: 1) Kinematics and Fine Motion Planning; 2) The dynamics and control of kinematically redundant robot arms including snake-like robots, multi-fingered robotic hands; 3) Methods of nonholonomic motion planning for space robots, multifingered robot hands, and mobile robots; and 4) New techniques in analytical mechanics for writing the dynamics of complicated multi-body systems subject to constraints on angular momentum or other nonholonomic constraints. The emphasis will be on those conceptual problems of robotics that are fundamental to understanding a very technologically driven and interdisciplinary field. The workshop will highlight the mathematical problems but the participants will also be shown video tapes of multifingered hands, redundant robots, and nonholonomic motion planning for space robots and mobile robots.

W.S. Levine is organizing a mini-symposium February 1–3 on **Biological Control of Movement**. The study of the means by which animals and humans perform voluntary movements presents interesting and challenging mathematical problems. The primary purpose of this informal workshop is to interest mathematicians in these problems. This will be done by exposing them to recent experimental results that pose fundamental questions about how movement is controlled as well as to recent theoretical results aimed at answering

these questions. The minisymposium will bring together some of the leading experimentalists, analysts, and theoreticians in this broad and deep subject. The talks and discussions will focus on the current status of research and on the formulation of problems of interest to both mathematicians and specialists in the biological control of movement.

A workshop on **Nonsmooth Analysis and Geometric Methods in Deterministic Optimal Control** will be held February 8–17, with V. Jurdjevic, B.S. Mordukhovich, R.T. Rockafellar, and H.J. Sussmann as organizers. The purpose of this two-part meeting is to concentrate on powerful mathematical techniques that have been developed in deterministic optimal control theory after the basic foundations of the theory (existence theorems, Maximum Principle, dynamic programming, sufficiency theorems for sufficiently smooth fields of extremals) were laid out in the 1960s. These advanced techniques make it possible to derive much more detailed information about the structure of solutions than could be obtained in the past, and they support new algorithmic approaches to the calculation of such solutions. In addition to the theoretical side, there will be attention given to applications such as recent work on robotics problems, the control of chemical batch processes, economic models, hierarchical models, and some problems involving uncertainty. Numerical results will also be taken up. The first five days will be devoted to topics primarily involving geometric methods, and the last five to topics related to nonsmooth analysis methods. The two-day overlap will be devoted to the discussion of issues where both lines of research come together.

On March 15–19 there will be a workshop on **Systems and Control Theory for Power Systems**, organized by J. Chow, P.V. Kokotovic, and R.J. Thomas. Future electric power systems will be expected to satisfy extraordinary performance and reliability requirements and to tolerate pronounced dynamic behavior while remaining amenable to diagnostics and maintenance. Mathematical theory is expected to play a significant role in an-

alyzing, designing, and operating these future systems. The emphasis of this workshop will be on the role of mathematical theory in the analysis and control of nonlinear dynamics in large-scale electric power systems. The topics to be discussed will include: 1) Modeling of large power systems using invariant and integral manifold theory; 2) Security assessment and enhancement problems including current research methodology for solution of these problems. Areas such as direct methods, voltage stability analysis, and structural stability analysis will be presented; and 3) Control system design considerations including measurement-based control, nonlinear control, parametric robust control, and decentralized and distributed control.

For more information about IMA activities, see the Meetings and Conferences section of this issue or contact the IMA, (ima_staff@ima.umn.edu). Also, weekly IMA seminar schedules with titles and abstracts are available on Usenet: umn.math.dept, and TeX files for the Newsletter and the Update are available via anonymous ftp (at ima.umn.edu).

News from the Mathematical Sciences Institute Cornell University

The Army Research Office Center of Mathematical Excellence, located at Cornell University's Mathematical Sciences Institute (MSI), is preparing to welcome a distinguished group of visiting scholars during the late summer and early fall of 1992.

MSI Director Anil Nerode will host Bakhadyr Khossainov during the 1992–1993 academic year. Khossainov has recently been a visitor at the University of Washington. Rod Downey from the University of Wellington, New Zealand is currently in residence at MSI and Professor D. Bridges from the University of Waikato, Hamilton, New Zealand and Dr. Y. Tabesh from Sharif University, Iran are expected to visit.

The Center for Stochastic Analysis, under the direction of Richard Durrett, has filled its two postdoctoral positions for academic years 1992–1994. The Center will host Itai Benjamini from the Hebrew University of Jerusalem and

Kathleen Crowe, who has been a visiting assistant professor at UC, Davis. Benjamini will continue his work on Brownian motion on manifolds. Crowe, who received her degree from the University of Arizona, will fill a position reserved for researchers from groups underrepresented in mathematics. She will work on biological problems with Carlos Castillo-Chavez. Ken Hochberg from Bar-Ilan University will visit during the fall semester. R. Dobrushin from the Institute for Problems of Information Transmission, Russia will visit during the spring semester.

The Center for Symbolic Methods in Algorithmic Mathematics, directed by Moss Sweedler, will host visits from Nicolai Vorobjov and Kiyoshi Shirayanagi. Shirayanagi is with the NTT Communication Science Laboratory.

News from the Fields Institute

The Fields Institute Distinguished Lecture Series will continue this fall with lectures by Vaughan Jones, University of California, Berkeley (September 23, 24, and 25, 1992) on operator theory, knots, and mathematical physics and by Michael Berry, University of Bristol, (October 22, 23, and 24, 1992) who will speak on quantum and classical asymptotics, chaology, and the Riemann zeros.

The main focus of the Institute's activities for 1992–1993 is its program on Dynamical Systems and Bifurcations. The first of the short courses for graduate students and faculty will be given by Institute Director Jerrold E. Marsden. The course, entitled Lectures on Hamiltonian Bifurcation Theory, will run from September 23–26, 1992. The first workshop of the Dynamical Systems year will be on Conservative Systems and Quantum Chaos (October 21–25, 1992). This workshop will focus on bifurcation and integrability problems in Hamiltonian systems.

For further information about the Institute please contact Liz Reidt at The Fields Institute for Research in Mathematical Sciences, 185 Columbia St. West, Waterloo, Ontario Canada, N2L 5Z5; Tel.: 519-725-0096, Fax: 519-725-0704; reidt@fields.uwaterloo.ca.

For the October workshop please email: chaos@fields.uwaterloo.ca or the organizers: David Goodings (goodings@physun.physic.mcmaster.ca) or David Rod (rod@acs.ucalgary.ca).

Model Programs Sought

The Mathematical Association of America (MAA) has received funding from the National Science Foundation to prepare, for the mathematical community, descriptions of highly successful undergraduate mathematical sciences programs. We are searching for programs that enhance recruitment and retention of mathematics majors; programs that prepare a substantial number of students effectively for teaching school mathematics or for continued graduate study; or programs that are particularly effective in attracting, and addressing the needs of, groups traditionally underrepresented in mathematics. Alan Tucker, chair of MAA's Education Coordinating Council, is the project director. MAA invites readers to nominate programs (including their own) for possible inclusion in this case studies project. Send your nomination letter to Professor Alan C. Tucker, Applied Mathematics Department, SUNY-Stony Brook, Stony Brook, NY 11794 (email: atucker@sbccmail.bitnet).

Report on Preparation of Teachers

"Mathematics education in the United States today is a vast enterprise involving millions of teachers and tens of millions of students... Along with reading, it is the most important item on our schools' agenda. Yet by nearly every measure, mathematics education in the United States today is a failure." So begins a report of a two-part conference held at the University of Chicago. Bringing together more than three dozen mathematicians, mathematics educators, psychologists, college administrators, and classroom teachers, the conference aimed to identify specific steps that need to be taken at the college level to improve the mathematical preparation of preservice elementary school teachers.

The report, entitled simply "On the Mathematical Preparation of Elementary

School Teachers", is unusually brief for a report on this topic, running only seventeen pages. As the report points out, more detailed ideas and perspectives may be found in such documents as *Professional Standards for Teaching Mathematics, Curriculum, and Evaluation Standards for School Mathematics, Everybody Counts*, and *A Call for Change*. This report makes a persuasive case for the idea that there is plenty of information on what to do—what is needed is the will to do it.

The report's main conclusion is that more attention must be paid to what kind of mathematics elementary school teachers learn, how they learn it, and how they bring their knowledge to bear on actual classroom practice. Among the report's specific recommendations are a coordinated national effort to bring about "a complete overhaul of the way elementary teachers are taught college mathematics", the adoption of a 12-semester-hour minimum for the mathematical preparation of elementary school teachers, and "bridges" between colleges and elementary schools for the continued professional development of elementary school teachers. Mathematics faculty don't get off easy in this report—one recommendation calls for institutes designed to improve the teaching methods of college faculty who are responsible for the mathematical preparation of teachers. The report also declares that "the mathematics community—specifically the AMS and the Mathematical Association of America (MAA)—must go clearly and explicitly on record as recognizing the importance of their critical role in preparing elementary school teachers to teach mathematics".

Now that the report is out, two other initiatives are under way. The first is a survey of all U.S. colleges graduating significant numbers of education majors, which will gather information on the mathematics components of the preparation of elementary school teachers. The second is a proposal submitted to the National Science Foundation for a planning grant to begin laying the foundation for one of the more significant ideas in the report: the creation of a college mathematics program specifically

intended to meet the needs of elementary teachers.

Copies of the report are available for \$4 (includes shipping and handling) from: Sheila Sconiers, University of Chicago, Department of Education, 5835 South Kimbark Avenue, Chicago, IL 60637-1609; telephone 312-702-1561.

Mathematics Awareness Week 1993

"Mathematics and Manufacturing" April 25–May 1, 1993

Every year, Mathematics Awareness Week celebrates the richness and relevance of mathematics and provides an excellent opportunity to convey this message through local events. During a week-long celebration from Sunday, 25 April – Saturday, 1 May 1993, the festivities will highlight Mathematics and Manufacturing. Mark your calendars now and plan to observe Mathematics Awareness Week in your area, school, or organization. Look for further information from the Joint Policy Board for Mathematics, national sponsor of Mathematics Awareness Week, in future issues of the *Notices*.

Special Reduced Rates for AMS Members

As a result of negotiations between the American Mathematical Society and J. C. Baltzer AG Scientific Publishing Company, AMS members can now take advantage of a special reduced rate on the following journals:

- *Annals of Operations Research*, US \$80 per volume
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- *Journal of Mathematical Chemistry*, US \$93 per volume
- *Numerical Algorithms*, US \$92 per volume
- *Queueing Systems*, US \$93 per volume
- *Telecommunication Systems*, US \$92 per volume.

This offer is being made exclusively to individual members of the American Mathematical Society.

In order to obtain this special discount, please send your order, stating your AMS membership code, directly

to the address mentioned below. The publisher will be happy to supply you with leaflets, containing all the necessary bibliographic information.

Please contact: In the United States: J. C. Baltzer AG, Scientific Publishing Company, P.O. Box 8577, Red Bank, NJ 07701-8577; from all other countries: J. C. Baltzer AG, Scientific Publishing Company, Wettsteinplatz 10, CH-4058 Basel, Switzerland, Fax: +41-61-692 42 62.

Enhanced Employment Register Interview Scheduling System

Mathematics job seekers and employers will be pleased to learn that an enhanced interview scheduling system is under development by the AMS, and it should

be available for use at the upcoming San Antonio Employment Register. The new system is based on computer code being developed by J. P. Jarvis, D. R. Shier, and M. Myers of the Department of Mathematical Sciences, Clemson University, under a contract jointly sponsored by AMS and MAA.

While maintaining the Employment Register tradition of maximizing the number of total interviews, the new system will support assigning various levels of priority to certain classes of interview requests. One class of interviews which will be assigned top priority are mutual requests, i.e., instances where an employer and an applicant request each other. Early tests indicate that virtually all such mutual requests will be scheduled during the two days of the

register. A full set of priorities and revised guidelines for the new system are being developed by the AMS-MAA-SIAM Joint Committee on Employment Opportunities.

The October issue of the *Notices* will contain complete information on the San Antonio Employment Register, including information on preregistration for the register.

Erratum

Bylines were inadvertently omitted on two articles in the July/August 1992 issue of the *Notices*. "Canada's Fields Institute Opens its Doors," pages 564-566, and "AMS Operating Plan for 1993," pages 597-598, were both written by AMS Staff Writer Allyn Jackson.

Advances in Soviet Mathematics

Properties of Global Attractors of Partial Differential Equations

A. V. Babin and M. I. Vishik, Editors

Volume 10

The four papers in this volume examine attractors of partial differential equations, with a focus on investigation of elements of attractors. Considered here is the dependence of attractors on singular perturbations of the equations. The theory of unbounded attractors of equations without bounded attracting sets is also covered. All of the articles are systematic and detailed, furnishing an excellent review of new approaches and techniques developed by the Moscow school.

1991 *Mathematics Subject Classification*: 35, 58, 76

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Funding Information for the Mathematical Sciences

Research at Foreign Centers

Through its program for long-term research at foreign centers of excellence, the National Science Foundation (NSF) seeks to increase the presence of young U.S. investigators in foreign laboratories and research institutions.

Awards are made for research in any field of science or engineering supported by the NSF for visits of three to twelve months. Appropriate foreign science and technology centers include industrial research laboratories, government research laboratories and centers, privately sponsored nonprofit institutions, and universities.

The annual deadline for submissions is **November 1**. For more information, contact: Division of International Programs, Room V-501, National Science Foundation, 1800 G Street, NW, Washington, DC 20550; telephone 202-653-5387.

Grants Available for Calculus Projects

The National Science Foundation (NSF) funds projects to improve mathematics curricula through its Curriculum Development in Mathematics: Calculus and Bridge to Calculus Program. The program is managed by the Division of Undergraduate Education, in cooperation with the Division of Mathematical Sciences and the Division of Elementary, Secondary, and Informal Science Education.

Proposals are solicited in three general categories: 1) projects to revitalize calculus instruction on a large scale involving students at the collegiate and/or secondary levels; 2) new curriculum development projects, particularly for the second year of calculus, including linear algebra and differential equations; and 3) curriculum development projects focused on preparation for calculus.

In recent years, mathematics faculty nationwide have implemented major changes in calculus instruction. While approaches have varied greatly, the emphasis has been on raising student conceptual understanding, problem solving skills, and analytical and transference skills, as well as on implementing new methods that reduce tedious calculations and place the student in the role of an active learner. Some of the projects have had NSF support, some have received other external support, and others have been developed with only institutional support.

Information about more than seventy such projects may be found in the report of the Mathematical Association of America, "Priming the Calculus Pump: Innovations and Resources". Additional reports have appeared in issues of *UME Trends* and have been presented at conferences and at sessions of meetings of professional societies. With information about successful models at hand, the challenge now is to include large numbers of students in the renewed calculus courses.

The closing date for proposals to the NSF's calculus program is **December 7, 1992**. More information and program announcements may be obtained from the program director, James Lightbourne, Division of Undergraduate Education, Room 1210, National Science Foundation, 1800 G Street, NW, Washington, DC 20550; telephone 202-357-7292; email jhlightb@nsf.gov (Internet) or jhlightb@nsf (Bitnet).

Mathematical Sciences Postdoctoral Research Fellowships

The National Science Foundation's (NSF) Mathematical Sciences Postdoctoral Research Fellowship program is designed to permit recipients to choose

research environments that will have maximal impact on their future scientific development. Awards will be made for appropriate research in pure mathematics, applied mathematics and operations research, and statistics at an appropriate nonprofit United States institution.

The fellowships will be offered only to persons who 1. are citizens, nationals, or lawfully admitted permanent resident aliens of the United States as of January 1, 1993; 2. will have earned, by the beginning of their fellowship tenure, a doctoral degree in one of the mathematical sciences; 3. will have held the doctorate for no more than five years as of January 1, 1993; and 4. will not previously have held any other NSF postdoctoral fellowship. Subject to the availability of funds, it is expected that in FY 1993, thirty to forty awards will be made. The evaluation of applicants will be based, in part, on ability as evidenced by past research work and letters of recommendation, likely impact on the future scientific development of the applicant, and scientific quality of the research likely to emerge. Applicants' qualifications will be evaluated by a panel of mathematical scientists. Women, underrepresented minorities, and persons with disabilities are strongly encouraged to submit applications.

For copies of the application brochure or further information, contact the Office of Special Projects, Room 339, Division of Mathematical Sciences, National Science Foundation, 1800 G Street, NW, Washington, DC 20550; 202-357-3453; email msprf@nsf.gov (internet) or msprf@nsf (bitnet) or the American Mathematical Society, 401-455-4104; email nsfpostdocs@math.ams.com.

The deadline for applications is **October 15, 1992**. *Please note that this deadline is one month earlier than in the years prior to 1991.*

Acknowledgment of Contributions

The officers and the staff of the Society acknowledge with gratitude gifts and contributions received during the past year. Contributing members of the Society paid dues of \$156 or more. In addition to contributions to the AMS Centennial Fellowship Fund, there were a number of unrestricted general contributions. Some of the contributors have asked to remain anonymous. All of these gifts provide important support for the Society's programs. Also listed are AMS members who contributed, through the Society, to the International Mathematical Union's Special Development Fund for travel grants to young mathematicians from developing countries. This year, gifts to the Society's Memorial Gift Program are included in this list. The names listed below include those whose contributions were received during the year ending March 31, 1992.

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Memorial and commemorative gifts are a distinctive and thoughtful way to memorialize or honor a colleague, friend, or family member and to support the Society's work to promote mathematical scholarship and research.

The Society acknowledges these gifts upon receipt of the gift and through the listing below. The list designates gifts made through March 1992. In addition, notification of the gift is sent to persons designated by the donor.

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In Honor of Arnold Ross
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1992 AMS Elections

In an effort to increase the number of ballots returned in the election process, the Society has decided to include in the *Notices* all the pertinent election material, including biographies and statements of the candidates in the upcoming election. The information is provided in order to assist the members in filling out the ballots that will soon be mailed. The officers of the Society encourage the members to return ballots.

I urge you to study the material printed below. More importantly, I urge you to look for the ballot that will arrive shortly in the mail and to return a completed ballot. In recent elections, only 15% of the members participated. I hope this figure can be greatly increased.

Robert Fossum
Secretary

Candidates

OFFICERS

Vice-President (one to be elected)

Melvin Hochster Anil Nerode

Member-at-Large of the Council (five to be elected)

James H. Curry	Peter Li
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Board of Trustees (one to be elected)

Roy L. Adler Richard W. Beals

NOMINATING COMMITTEE FOR 1993

(Approval voting, three to be elected)

Jerome A. Goldstein	Louise A. Raphael
Vaughan F. R. Jones	Yum Tong Siu
Brian J. Parshall	Nancy K. Stanton

EDITORIAL BOARDS COMMITTEE FOR 1993

(Approval voting, two to be elected)

Bryan J. Birch	Paul H. Rabinowitz
Fan R. K. Chung	Masamichi Takesaki

Election Information

The ballots for election of members of the Council and Board of Trustees of the Society for 1993 will be mailed on or shortly after September 10, in order for members to receive their ballots well in advance of the November 10 deadline. Prior to casting their ballots members are urged to consult the following articles and sections of the Bylaws of the Society: article I, section 1; article II, sections 1, 2; article III, sections 1, 2, 3; article IV, sections 1, 2, 4; article VII, sections 1, 2, 5. The complete text of the Bylaws appears on pages 1177-1182 of the November 1991 issue of the *Notices*. A list of the members of the Council and Board of Trustees serving terms during 1992 appears in the **AMS Reports and Communications** section of this issue.

REPLACEMENT BALLOTS

This year ballots for the AMS election will be mailed September 10, 1992, or within a day or two thereafter. The deadline for receipt of ballots is November 10, 1992.

There has been a small but recurring and distressing problem concerning members who state that they have not received ballots in the annual election. It occurs for several reasons, including failure of local delivery systems on university or corporate properties, failure of members to give timely notice of changes of address to the Providence office, failures of postal services, and other human errors.

To help alleviate this problem, the following replacement procedure has been devised: A member who has not received a ballot by October 10, 1992, or who has received a ballot but has accidentally spoiled it, may write after that date to the Secretary of the AMS, Post Office Box 6248, Providence, RI 02940, asking for a second ballot. The request should include the individual's member code and the address to which the replacement ballot should be sent. Immediately upon receipt of the request in the Providence office, a second ballot, which will be indistinguishable from the original, will be sent by first class or air mail. It must be returned in an inner envelope, which will be supplied, on the outside of which is the following statement to be signed by the member:

The ballot in this envelope is the only ballot that I am submitting in this election. I understand that if this statement is not correct then no ballot of mine will be counted.

signature

Although a second ballot will be supplied on request and will be sent by first class or air mail, the deadline for receipt of ballots will not be extended to accommodate these special cases.

SUGGESTIONS FOR 1993 NOMINATIONS

Each year the members of the Society are given the opportunity to propose for nomination the names of those individuals they deem both qualified and responsive to their views and needs as part of the mathematical community. Candidates will be nominated by the Council to fill positions on the Council and Board of Trustees to replace those whose terms expire January 31, 1994. See the **AMS Reports and Communications** section of this issue for the list of current members of the Council and Board of Trustees. Members are requested to write their suggestions for such candidates in the appropriate spaces below.

SUGGESTIONS FOR 1993 NOMINATIONS

President-Elect (1)

Vice-President (1)

Members-at-large of the Council (5)

Member of the Board of Trustees (1)

The completed form should be addressed to AMS Nominating Committee, Post Office Box 6248, Providence, RI 02940, to arrive no later than **November 10, 1992**.

Biographies of Candidates

1992

Biographical information about the candidates has been verified by the candidates, although in a few instances, prior travel arrangements of the candidate at the time of assembly of the information made communication difficult or impossible. A candidate had the opportunity to make a statement of not more than 200 words on any subject matter without restriction and to list up to five of her or his research papers.

Abbreviations: American Association for the Advancement of Science (AAAS); American Mathematical Society (AMS); American Statistical Association (ASA); Association for Computing Machinery (ACM); Association for Symbolic Logic (ASL); Association for Women in Mathematics (AWM); Canadian Mathematical Society, Société Mathématique du Canada (CMS); Conference Board of the Mathematical Sciences (CBMS); Institute of Mathematical Statistics (IMS); International Mathematical Union (IMU); London Mathematical Society (LMS); Mathematical Association of America (MAA); National Academy of Sciences (NAS); National Academy of Sciences/National Research Council (NAS/NRC); National Aeronautics and Space Administration (NASA); National Council of Teachers of Mathematics (NCTM); National Science Foundation (NSF); Operations Research Society of America (ORSA); Society for Industrial and Applied Mathematics (SIAM); The Institute of Management Sciences (TIMS).

An (*) indicates the individual was nominated in response to a petition.

Vice President

Melvin Hochster

Professor, University of Michigan

Born: August 2, 1943, Brooklyn, New York

Ph.D.: Princeton University, 1967

Offices: Member-at-large of the Council, 1982–1986.

AMS Committees: Committee to Select Hour Speakers for Western Sectional Meetings, 1977–1979 (Chair, 1979); *Bulletin* Editorial Committee (Associate Editor, Research Announcements), 1981–1983; Program Committee for National Meetings, 1982–1984 (Chair, 1983–1984); Executive Committee of the Council, 1983–1986; *Mathematical Reviews* Editorial Committee, 1984–1989 (Chair, 1984–1989); Committee on Long Range Planning, Board of Trustees, 1985 (Chair); Committee to Select the 1985 Cole Prize in Algebra; Mathematical Reviews-Zentralblatt Negotiating Team, 1985; Committee to Select the 1990 Cole Prize in Algebra (Chair).

Selected Addresses: Invited Address, San Antonio, January 1976; International Congress of Mathematicians, Helsinki, August 1978.

Additional Information: Principal Lecturer, CBMS Regional Conference, University of Nebraska, 1974; Principal Lecturer, CBMS Regional Conference, George Mason University, 1979; Frank Nelson Cole Prize in Algebra, 1980; Guggenheim Fellow, 1982; Board of Trustees, MSRI, 1985–1987; Board of Governors, IMA, 1985–1987; Scientific Advisory Council, MSRI, 1989–1993 (Chair, 1992–1993); Human Resources Committee, MSRI, 1992– (Chair); Member: AMS, MAA, AWM.

Selected Publications: 1. with J. L. Roberts, *Rings of invariants of reductive groups acting on regular rings are Cohen-Macaulay*, Adv. in Math. **13** (1974), 115–175. MR **50** #311; 2. *Topics in the homological theory of modules over commutative rings*, Proc. Nebraska Regional CBMS Conference, CBMS Regional Conference Series in

Math., No. 24, Amer. Math. Soc., 1975. MR **51** #8096; 3. with Craig Huneke, *Tight closure, invariant theory, and the Briancon-Skoda theorem*, J. Amer. Math. Soc. **3** (1990), 31–116. MR **91g** #13010; 4. with Craig Huneke, *Infinite integral extensions and big Cohen-Macaulay algebras*, Ann. of Math. **135** (1992), 53–89.

Statement: I am concerned with a current paradox. Federal funds are being poured into graduate support at a time when the job market is dreadful, while traditional funding for researchers, already inadequate, is being steadily eroded.

Anil Nerode*

Goldwin Smith Professor of Mathematics and Director of the Mathematical Sciences Institute, Cornell University

Born: June 4, 1932, Los Angeles, California

Ph.D.: University of Chicago, 1956

AMS Committees: Committee on Science Policy, 1976–1978.

Selected Addresses: Summer Research Institute on Recursion Theory, Ithaca, June–July 1982; Logic in Computer Science, IEEE Conference, Boston, 1986; Asian Logic Colloquium, Beijing, China, 1988; Logic Week, Oberwolfach, 1989; Logical Foundations of Computer Science, TVER92, Tver, Russia, 1992.

Additional Information: The Committee on Applied Mathematics of the NRC, 1967–1970; Council, Association for Symbolic Logic, 1968–1983; The NSF Advisory Panel for Mathematical Sciences, 1970–1973; Chair, Department of Mathematics, Cornell University, 1982–1987; NRC Computational Mathematics Ad Hoc Panel, 1984; Distinguished

Visiting Scientist, U.S. Environmental Protection Agency, 1985–1987; Science Advisory Board of the U.S. Environmental Protection Agency, 1986–; Advisory Board, The Center for Intelligent Control of MIT-Brown-Harvard, 1987–; Advisory Panel, The Army High Performance Computing Institute, University of Minnesota 1989–; Advisory Board, The Center for AI, University of Pennsylvania, 1991. Editor: *Proceedings of the American Mathematical Society*, 1962–1965; *Journal of Symbolic Logic*, 1967–1983; *Annals of Pure and Applied Logic*, 1984–; *Future Generation Computing*, 1984–; *Annals of Mathematics and AI*, 1990–; Member: AMS, MAA, ASL, AWM, ACM, IEEE, SIAM. **Selected Publications:** 1. *Diophantine correct non-standard models in the isols*, *Ann. Math.* **84** (1966), 421–432. MR **34** #2465; 2. with J. N. Crossley, *Combinatorial functors*, *Ergebnisse series*, Springer-Verlag, New York-Heidelberg, 1974. MR **52** #10397; 3. with G. Metakides, *Effective content of field theory*, *Ann. Math. Logic* **17** (1979), 289–320. MR **82b**:03082; 4. with J. B. Remmel and W. Marek, *Non-monotone rule systems. I.*, *Ann. Mathematics and Artificial Intelligence*, 1991; 5. with A. Yakhnis and Y. Yakhnis, *Concurrent programs as strategies in games*, *Logic From Computer Science* (Y. N. Moschovakis, ed.), Springer-Verlag, New York-Heidelberg, 1992, pp. 405–480.

Statement: If elected, I would help AMS take a lead in: (1) Promoting the unity of the mathematical sciences; (2) Integrating mathematics with the rest of scientific life; (3) Making contributions of mathematics to government, business and industry known to the Public and Congress; (4) Integrating the teaching community with the research community; (5) Identifying the mathematically talented among minority groups and women, drawing them into our community. Besides a long research career under NSF, ARO, ONR, AFOR, and many other sources of research support, I have: had thirty-four Ph.D. students, including Louise Hay and Charlotte Lin (I joined AWM at its inception); run MAT programs (NSF); been consultant for MAA for about eighty colleges; initiated a freshman program to hold students in

mathematics (EXXON); initiated a program to bring college teachers into the University for updating (PEW, DANA); initiated many dozens of conferences in new areas (MSI); been a consultant for EPSCOR Kentucky and Puerto Rico; initiated cooperative research programs with minority institutions; advised many government and industrial laboratories and institutes. I have also worked with EPA for fourteen years, have been on the U.S. Environmental Protection Agency Science Advisory Board, and am currently Chair, USEPA Global Change Program Technical Advisory Panel.

Member-at-Large of the Council

James H. Curry

Professor of Applied Mathematics, University of Colorado, Boulder

Born: July 24, 1948, Oakland, California

Ph.D.: University of California, Berkeley, 1976

AMS Committees: Committee on Communications, 1992–.

Selected Addresses: AMS Summer Seminar on Factorization Algorithms, Fort Collins, July 1988; Conference on Chaos and Strange Attractors, University of Colorado, Denver, 1988; Conference on the Numerical Solution of Simple Equations, Clarkson University, 1988; Conference on Bairstow's Algorithm, University of Minnesota, 1989; Conference on Polynomial Factorization Algorithms, University of California, Davis, May 1989.

Additional Information: NSF Postdoctoral Fellowship Evaluation Panel, 1990–.

Selected Publications: 1. with Sharon L. Blish, *On the geometry of factorization algorithms*, *Computational Solution of Nonlinear Systems of Equations*, *Lectures in Appl. Math.*, vol. 26, pp. 47–60, *Amer. Math. Soc.*, Providence, RI, 1990; 2. *Eye of Newton: The Movie*, September 1989.

Gloria C. Hewitt

Professor, University of Montana

Born: October 26, 1935, Sumter, South Carolina

Ph.D.: University of Washington, 1962

AMS Committees: Committee on Local Arrangements for the Summer Meet-

ing in 1973; AMS-MAA-NCTM-SIAM Committee on Women in the Mathematical Sciences, 1984; AMS-ASA-IMS-MAA-NCTM-SIAM Committee on Women in the Mathematical Sciences, 1985–1986.

Selected Addresses: Limits of Universal Algebras, Missoula, 1976; Noetherian Conditions, Cleveland, 1978; Category Theory and Automata (Series of Lectures), Cleveland, 1981; Generalized Noetherian Rings, China, 1990; Polynomial Rings Which are Principal Ideal Rings, China, 1990.

Additional Information: NSF Fellow, 1966; MAA Visiting Lecturer, 1964–1972; Executive Council of Pi Mu Epsilon, 1972–1975; GRE Examination Committee, 1976–1986 (Chair, 1984–1986); College Board AP Calculus Development Committee, 1987–1991; GRE Technical Advisory Committee, 1992–; MAA (PNW) Distinguished Teaching Award Committee, 1992; CUPM Subcommittee on Assessment, 1990–1994; Member: AWM, MAA, NAM.

Selected Publications: 1. *The existence of free unions in classes of abstract algebras*, *Proc. Amer. Math. Soc.* **14** (1963), 417–422. MR **26** #6098; 2. *Limits in certain classes of abstract algebras*, *Pacific J. Math.* **22** (1967), 109–115. MR **35** #1529; 3. *Characterizations of generalized Noetherian rings*, *Acta Math. Hungar.* **53** (1989), 61–73. MR **90g**:16039.

Svetlana R. Katok

Associate Professor, Pennsylvania State University

Born: May 1, 1947, Moscow, Russia

Ph.D.: University of Maryland, 1983

Selected Addresses: Summer Research Conference on Kleinian Groups, Boulder, August 1983; Conference on Geometry, Lie Groups and Ergodic Theory, Mathematical Sciences Research Institute, Berkeley, May 1984; Colloquium Lecture, University of California, San Diego, February 1986; International Centre for Theoretical Physics, Trieste, Italy, July 1990; Workshop on Discrete Groups, Number Theory and Ergodic Theory, Mathematical Sciences Research Institute, Berkeley, November 1991.

Additional Information: NSF Postdoctoral Research Fellow, 1986–1988;

Seminar Leader, Summer Mathematics Institute, Intensive Mathematics Program for Women Undergraduates, NSF Special Project, Mills-Berkeley, June–July 1991; Member: AMS, AWM.

Selected Publications: 1. *Closed geodesics, periods and arithmetic of modular forms*, Invent. Math. **80** (1985), no. 3, 469–480. MR **86j**:11048; 2. *Approximate solutions of cohomological equations associated with some Anosov flows*, Ergodic Theory Dynamical Systems **10** (1990), no. 2, 367–379. MR **91g**:58120; 3. *Elliptic operators and solutions of cohomological equations for geodesic flows with hyperbolic behavior*, Internat. J. Math. **2** (1991), 701–709; 4. *Fuchsian groups*, The University of Chicago Press, to appear; 5. with P. Sarnak, *Heegner points, cycles and Maass forms*, to appear.

Statement: I believe that AMS should exercise leadership in the commitment of the research mathematics community to excellence in undergraduate education. Together with improvement of graduate support, this will make mathematics more attractive as a career and will bring the best talent to the profession.

Steven George Krantz

Professor, Washington University

Born: February 3, 1951, San Francisco, California

Ph.D.: Princeton University, 1974

Selected Addresses: Invited Lectures: Stanford University, 1987; Mittag-Leffler Institute, 1988; International Complex Analysis Conference, Cetraro, Italy, 1989; National Academy of Sciences Frontiers of Science Forum, 1990; Yale University, 1991.

Additional Information: NSF Fellow, 1975–; Chauvenet Prize, MAA, 1992; Member: AMS.

Selected Publications: 1. *Holomorphic functions of bounded mean oscillation and mapping properties of the Szegő projection*, Duke Math. J. **47** (1980), 743–761. MR **82i**:32010; 2. with R. E. Greene, *Deformations of complex structure, estimates for the $\bar{\partial}$ -equation, and stability of the Bergman kernel*, Adv. in Math. **43** (1982), 1–86. MR **84b**:32026; 3. with R. E. Greene, *The automorphism groups of strongly pseudoconvex do-*

*main*s, Math. Ann. **261** (1982), 425–446. MR **84c**:32032; 4. *Invariant metrics and the boundary behavior of holomorphic functions on domains in $\mathbb{C}^n$* , J. Geom. Anal. **1** (1991), 71–98; 5. *Convexity in complex analysis*, Proc. Sympos. Pure Math., vol. 52, part 1 (E. Bedford, J. D'Angelo, R. Greene, and S. Krantz, eds.), American Mathematical Society, Providence, RI, 1991, pp. 119–137.

Statement: The two most severe crises facing our professions today are the shortage of jobs and the difficulty of obtaining research funding. Although the first crisis stems in part from transient social phenomena, the end is not in sight. The second crisis is also complicated, is linked in part with rising salaries and shortage of money, but also has complex social aspects. In any event, the two problems are proving disheartening both to those who are considering entering the profession and to those who are already established as mathematicians. I would like to see the AMS council seek methods to deal with the job crisis and the funding situation.

I would also like the AMS council to function more openly and to be more accountable to the AMS membership at large. My personal experience with the council in the last few years has suggested that there is room for improvement in both these categories.

James I. Lepowsky

Professor, Rutgers University

Born: July 5, 1944, New York, New York

Ph.D.: Massachusetts Institute of Technology, 1970

AMS Committees: Contemporary Mathematics Editorial Committee (Associate Editor), 1980–1985; AMS-IMS-SIAM Committee on Joint Summer Research Conferences in the Mathematical Sciences, 1987–1988.

Selected Addresses: International Congress of Mathematicians, Helsinki, August 1978; Invited Address, Duluth, August 1979; Special Session on Finite Group Theory, Anaheim, January 1985; Symposium on the Mathematical Heritage of Hermann Weyl, Duke University, May 1987; Summer Research Institute on Algebraic Groups and their Generalizations, Pennsylvania

State University, University Park, July 1991.

Additional Information: Member, Institute for Advanced Study, 1975–1976, 1980, 1985, 1987–1988; Sloan Fellow, 1976–1978; Visiting Associate Professor, Université Paris VI, 1978; Member, Mathematical Sciences Research Institute, 1983–1984; Guggenheim Fellow, 1987–1988; Organizer, Special Session on Infinite-Dimensional Symmetries in Mathematics and Physics, Worcester, April 1989; Organizing Committee, Workshop on Mathematical Ideas Arising from Conformal Field Theory, Aspen Center for Physics, 1989; Organizing Committee, AMS-IMS-SIAM Joint Summer Research Conference on Conformal Field Theory, Topological Field Theory and Quantum Groups, South Hadley, June 1992; Associate Editor of the new *Journal of Knot Theory and its Ramifications*; Member: AMS, MAA, AAAS, American Physical Society.

Selected Publications: 1. with R. L. Wilson, *Construction of the affine Lie algebra $A_1^{(1)}$* , Comm. Math. Physics **62** (1978), 43–53. MR **58** #28089; 2. with R. L. Wilson, *The structure of standard modules, I. Universal algebras and the Rogers-Ramanujan identities*, Invent. Math. **77** (1984), 199–290. MR **85m**:17008; 3. *Calculus of twisted vertex operators*, Proc. Nat. Acad. Sci. USA **82** (1985), 8295–8299. MR **88f**:17030; 4. with I. B. Frenkel and A. Meurman, *Vertex operator algebras and the Monster*, Pure and Applied Math., vol. 134, Academic Press, Boston, 1988. MR **90h**:17026; 5. with Y.-Z. Huang, *Toward a theory of tensor products for representations of a vertex operator algebra*, Proc. 20th International Conference on Differential Geometric Methods in Theoretical Physics, New York, 1991, S. Catto and A. Rocha, eds., World Scientific Publishing, Singapore, 1992, vol. 1, 344–354.

Statement: In conjunction with its primary goal of fostering innovative research, the AMS should continue, and seek new ways, to: (1) take an active role in the improvement of mathematics teaching at all levels; (2) emphasize to funding sources and to the general public the importance of mathematics—especially the kind of undirected basic

research carried out by individual investigators; (3) facilitate interdisciplinary interaction both within mathematics and between mathematics and other fields; (4) strongly encourage talented students, including women and members of minority groups, to consider mathematics as a career; and (5) provide a forum for mathematicians to discuss the relations between mathematics and society.

Peter Li

Professor, University of California, Irvine

Born: April 18, 1952, Hong Kong

Ph.D.: University of California, Berkeley, 1979

AMS Committees: AMS-IMS-SIAM Committee on Joint Summer Research Conferences in the Mathematical Sciences, 1990-; *Proceedings* Editorial Committee, 1991-; *Progress in Mathematics* Editorial Committee, 1991-.

Selected Addresses: Invited Address, Logan, October 1986; The 9th Congress of the International Association of Mathematical Physics: Session on Analysis of Manifold, Swansea, July 1988; Summer Research Institute on Differential Geometry: Plenary Address, Los Angeles, July 1990; MSRI Summer Program on Geometric Analysis, Berkeley, July–August 1990; Osaka Conference on Complex Geometry and Related Topics: Plenary Address, Osaka, December 1990.

Additional Information: Sloan Fellow, 1982; Guggenheim Fellow, 1989; *Proceedings of the American Mathematical Society*, (Coordinating Editor, Lie groups, geometry, and topology), 1992–1994.

Selected Publications: 1. with S. T. Yau, *On the parabolic kernel of the Schrödinger operator*, *Acta Math.* **156** (1986), 153–201. MR **87f**:58156; 2. with L. F. Tam, *Positive harmonic functions on complete manifolds with nonnegative curvature outside a compact set*, *Ann. of Math.* **125** (1987), 171–207. MR **88m**:58039; 3. *On the structure of complete Kähler manifolds with nonnegative curvature near infinity*, *Invent. Math.* **99** (1990), 579–600. MR **91c**:53063; 4. with L. F. Tam, *The heat equation and harmonic maps of complete manifolds*, *Invent. Math.* **105** (1991), 1–46; 5. with L. F. Tam, *Harmonic functions and the*

structure of complete manifolds, *J. Diff. Geom.*, to appear.

Statement: In the last 2 years, the job market in mathematics seems to have caved in overnight. This sudden change caught the mathematics community by surprise. It is crucial at this stage, to be able to project and accurately assess the future market. In this sense, it should be the responsibility of the American Mathematical Society to set up a task force to effectively deal with this problem.

Kenneth A. Ribet

Professor of Mathematics, University of California, Berkeley

Born: June 28, 1948, New York, New York

Ph.D.: Harvard University, 1973

AMS Committees: Committee on Far Western Sectional Meetings (Select Hour Speakers for), 1980–1981 (Chair).

Selected Addresses: Invited Address, Seattle, August 1977; Special Session on Arithmetical Algebraic Geometry, San Francisco, January 1991 (Organizer); Invited Address, San Francisco, January 1991; Special Session on Number Theory, Joint Meeting of the American and London Mathematical Societies, Cambridge, England, June 1992.

Additional Information: Organizing Committee, 1985 Summer Research Conference on Current Trends in Arithmetical Algebraic Geometry (Chair); NSF Postdoctoral Fellowship Evaluation Panel, 1988–1992 (Chair, 1992); Prix Fermat, 1989; Member, NSF Review Panel on Undergraduate Curriculum Development, 1990–1992.

Selected Publications: 1. *A modular construction of unramified p -extensions of $\mathbb{Q}(\mu_p)$* , *Invent. Math.* **34** (1976), 151–162. MR **54** #47424; 2. with P. Deligne, *Values of abelian L -functions at negative integers over totally real fields*, *Invent. Math.* **59** (1980), 227–286. MR **81m**:12019; 3. *Congruence relations between modular forms*, *Proc. 1982 ICM* (1985), 503–514; 4. *On modular representations of $\text{Gal}(\overline{\mathbb{Q}}/\mathbb{Q})$ arising from modular forms*, *Invent. Math.* **100** (1990), 431–476. MR **91g**:11066; 5. *From the Taniyama-Shimura conjecture to Fermat's last theorem*, *Annales de la Faculté des Sciences de l'Université de Toulouse* **11** (1990), 116–139.

Statement: I would be honored to serve as Member-at-Large of the Council. I come to the AMS with no platform or political agenda. I am acutely aware of the numerous challenges faced by our profession, and hope that I can make a contribution to sensible and equitable solutions.

Philip D. Wagreich

University of Illinois at Chicago

Born: July 25, 1941, New York, New York

Ph.D.: Columbia University, 1967

AMS Committees: Organizing Committee, 1981 Summer Institute on Singularities; Committee on NCTM Standards, 1989.

Selected Addresses: Special Session on Transformation Groups, Milwaukee, November, 1971; Special Session on Singularities, San Antonio, January, 1980; Summer Institute on Singularities, Arcata, July 1981; Special Session on Asymptotic Properties of Hyperbolic Groups, Anaheim, January 1985; Special Session on Mathematicians and Education Reform, Baltimore, January 1992.

Additional Information: ONR Postdoctoral Fellow, 1968–1969; Member, Institute for Advanced Study, 1968–1970; Co-organizer, U.S.–France Joint Seminar on Singularities, Paris, 1982; Co-organizer, U.S.–Japan Joint Seminar on Complex Analytic Singularities, Tsukuba, 1983; Director, University of Illinois at Chicago Office of Mathematics and Computer Education, 1985–1990; Co-director, Mathematicians Education Reform Network, 1988–; Member, MAA Committee on Mathematics Education of Teachers, 1990–; Member, Illinois Governor's Science Advisory Committee; Co-director, UIC Institute for Mathematics and Science Education; Member: MAA, NCTM.

Selected Publications: 1. with Peter Orlik, *Isolated singularities of algebraic surfaces with C^* -action*, *Ann. of Math.* **93** (1971), 205–228. MR **44** #1662; 2. *Algebras of automorphic forms with few generators*, *Trans. Amer. Math. Soc.* **262** (1980), 367–389. MR **82e**:10044; 3. with Howard Goldberg, *A model integrated mathematics science program for the elementary school*, *Perspectives*

on Research in Mathematics Education, International Journal of Educational Research **14** (2) (1990), 193–214; 4. with Howard Goldberg, *Teaching Integrated Math and Science: A Curriculum and Staff Development Project for the Elementary School*, *Mathematicians and Education Reform*, Proceedings of the July 6–8, 1988 Workshop, CBMS, Issues in Mathematics Education, vol. 1, Amer. Math. Soc., Providence, RI, 1990, pp. 63–130; 5. with Peter Shalen, *Growth rates, Z_p -homology, and volumes of hyperbolic 3-manifolds*, Trans. Amer. Math. Soc., to appear, 1992.

Statement: A vigorous research community depends upon a source of new students, the continuation of research funding, and understanding and acceptance by the general public. Therefore, in addition to the direct support of mathematics research, the AMS should involve itself in reform of mathematics education and in communication with government agencies and the general public. The AMS should find appropriate ways to facilitate the process of institutional and cultural change.

Jonathan M. Wahl

Professor, University of North Carolina, Chapel Hill

Born: January 29, 1945, Washington, DC

Ph.D.: Harvard University, 1971

AMS Committees: Committee on Human Rights, 1992.

Selected Addresses: Special Session on Stratification of Algebraic and Analytic Varieties, Ann Arbor, November 1976; Organizer, Special Session on Classification and Deformation of Singularities, Charleston, November 1978; Special Session on Singularities of Algebraic and Analytic Varieties, New York, April 1983; Invited Address, Canadian Mathematical Society Summer Seminar in Algebraic Geometry, Vancouver, July 1984; Invited Address, Fayetteville, March 1990.

Additional Information: Member, Institute for Advanced Study, 1972–1973, 1979; Director of Undergraduate Studies, UNC, 1981–1983; Organizer, Alfred Brauer Lectures at UNC, 1985–1992; Member: AMS.

Selected Publications: 1. *Equations defining rational singularities*, Ann. Sci. École Norm. Sup. **10** (1977), 231–263. MR **56** #3005; 2. *A cohomological characterization of $\mathbb{P}^n$* , Invent. Math. **72** (1983), 315–322. MR **84h**:14024; 3. with E. Looijenga, *Quadratic functions and smoothing surface singularities*, Topology **25** (1986), 261–291. MR **87j**:32032; 4. *Gaussian maps on algebraic curves*, J. Differential Geom. **32** (1990), 77–98. MR **91h**:14028; 5. *A characteristic number for links of surface singularities*, J. Amer. Math. Soc. **3** (1990), 625–637. MR **91c**:14043.

Statement: While the main purpose of the Society is to promote mathematical research, several survival issues must be addressed. Most importantly, the Council needs to have frank discussions about practical ways to stem the flow of American college and graduate students away from mathematics and the sciences. Because of the need to increase research support for individual investigators, a close look ought to be taken at the effect on NSF grants of the removal of the salary cap.

Susan Gayle Williams

Professor, University of South Alabama

Born: May 26, 1953, Orange, New Jersey

Ph.D.: Yale University, 1981

Selected Addresses: Special Session on Texas Topology and Geometry, Denton, November 1990; Conference on Symbolic Dynamics and its Applications, New Haven, August 1991; Colloque Arithmétique et Dynamique Symbolique, Marseille, September 1991; Special Session on Ergodic Theory and Dynamical Systems, Tuscaloosa, March 1992.

Additional Information: Organizer, Southeast Dynamical Systems Conference, Mobile, February 1990; Program Committee, Mathematical Sciences Research Institute Special Half-Year Program in Symbolic Dynamics, Fall 1992; Member: AMS, AWM.

Selected Publications: 1. *Toeplitz minimal flows which are not uniquely ergodic*, Z. Wahrsch. Verw. Gebiete **67** (1984), 95–107. MR **86k**:54062; 2. *A sofic system which is not spectrally of finite type*, Ergodic Theory Dynamical

cal Systems **8** (1988), 483–490. MR **90i**:28027; 3. *Covers of non-almost finite type sofic systems*, Proc. Amer. Math. Soc. **104** (1988), 245–252. MR **90c**:28028; 4. *Lattice invariants for sofic shifts*, Ergodic Theory Dynamical Systems **11** (1991), 787–802.

Statement: A substantial proportion of AMS members are faculty at small colleges and universities which have few resources to support research. This proportion is growing as the bleak job market causes more talented young mathematicians with a strong dedication to research to take jobs at less prestigious schools. This segment of the membership has little representation on the AMS Council, and it is sometimes overlooked. For example, the Academic Hiring Survey in the April *Notices* sampled only doctorate-granting institutions, and half of the 40 schools surveyed were chosen from the 39 “Group I” institutions.

If we want broad public support for mathematical research, we must convince the public that mathematics is not a product which can be manufactured by a few to be consumed by many; that knowledge and discovery go hand in hand at all levels of mathematics. The AMS will be in a better position to do this if its Council reflects the diversity of its membership.

Trustee

Roy L. Adler

Research Staff Member and Senior Manager, Mathematical Sciences Department, Research Division, IBM Corporation

Born: February 22, 1931, Newark, New Jersey

Ph.D.: Yale University, 1961

AMS Committees: Eastern Section Program Committee, 1992–.

Selected Addresses: Colloquium Lecture, Cornell University, 1964; Invited Address, Kalamazoo, August 1975; Summer Research Conference on Ergodic Theory and Applications, Durham, June 1982 (organizer); Keynote Speaker, Australian Mathematical Society, Monash University, Melbourne, May 1984; Principal Speaker, Special Year in Dynamical Systems, University of Maryland, December 1986; Colloquium Lecture,

Pennsylvania State University, October 1991.

Additional Information: Chair, Mathematical Sciences Research Institute Workshop, Berkeley, December 8–13, 1983; Panelist: National Science Research Council, Panel for Associateship Programs, 1986–; Trustee, Mathematical Sciences Research Institute, February 1986–1991; Chair: Coding Theory, Fourth SIAM Conference on Discrete Mathematics, San Francisco, June 1988; Member: Editorial Board, Ergodic Theory and Dynamical Systems, March 1989; Chair, Symbolic Dynamics Program, Mathematical Sciences Research Institute, Fall 1992; Fellow, New York Academy of Sciences, June 1985; IEEE, Information Theory Group 1985 Best Paper Prize.

Selected Publications: 1. with A. G. Konheim and M. H. McAndrew, *Topological entropy*, Trans. Amer. Math. Soc. **114** (1965), 309–319. MR **30** #5291; 2. with B. Weiss, *Similarity of automorphisms of the torus*, Mem. Amer. Math. Soc. **98** (1970). MR **41** #1966; 3. with B. Marcus, *Topological entropy and equivalence of dynamical systems*, Mem. Amer. Math. Soc. **219** (1979). MR **83h**:28027; 4. with D. Coppersmith and M. Hassner, *Algorithms for sliding block codes*, IEEE Trans. Inform. Theory **29** (1983), 5–22. MR **85b**:94009; 5. with L. Flatto, *Geodesic flows, interval maps, and symbolic dynamics*, Bull. Amer. Math. Soc. **25** (1991), 229–334.

Statement: It is incumbent upon a Trustee to see that issues of our profession are seriously attended to such as: scarcity of jobs, educational reform, inequities due to race and sex, government support of research, and careful use of Society funds. I shall try my best.

Richard W. Beals

Professor, Yale University

Born: May 28, 1938, Erie, Pennsylvania

Ph.D.: Yale University, 1964

AMS Committees: Committee on Steele Prizes, 1984–1987 (Chair, 1987); Editorial Board, *Contemporary Mathematics*, 1989– (Chair, 1990–).

Selected Addresses: Special Session on Partial Differential Equations, Minneapolis, November 1973; Invited Ad-

dress, Pittsburgh, August 1981; Special Session on Inverse Problems, Newark, April 1987; Summer Research Conference on Inverse Scattering and Applications, Amherst, June 1990.

Additional Information: Co-editor, *Communications in Partial Differential Equations*, 1976–1986; Member: AMS, MAA.

Selected Publications: 1. with C. L. Fefferman, *On local solvability of linear partial differential equations*, Ann. of Math. **97** (1973), 482–498. MR **50** #5233; 2. *A general calculus of pseudodifferential operators*, Duke Math. J. **42** (1975), 1–42. MR **51** #3972; 3. with R. R. Coifman, *Scattering and inverse scattering for first order systems*, Comm. Pure Appl. Math. **37** (1984), 39–90. MR **85f**:34020; 4. with P. C. Greiner and N. K. Stanton, *The heat equation on a CR manifold*, J. Differential Geom. **20** (1984), 343–387; 5. *Indefinite Sturm-Liouville problems and half-range completeness*, J. Differential Equations **56** (1985), 391–407.

Nominating Committee

Jerome A. Goldstein

Professor, Louisiana State University

Born: August 5, 1941, Pittsburgh, Pennsylvania

Ph.D.: Carnegie Mellon University, 1967

AMS Committees: Committee on Academic Freedom, Tenure, and Employment Security, 1986–1990

Selected Addresses: NATO Conference on the Mathematical Theory of Scattering, Denver, 1973; Opening Lecture, Conference Honoring Einar Hille, Laguna Beach, 1980; Conference on Aspects of Positivity in Functional Analysis, Tübingen, Germany, 1988; Fourth Annual Korea Institute of Technology Workshop (3 lectures), Taejon, Korea, 1989; 23rd Voronezh Winter School in Mathematics (3 lectures), Veronezh, Russia, 1990.

Additional Information: Member, Institute for Advanced Study, 1967–1968; Sigma Xi Faculty Research Award, Tulane University, 1970–1971; First Annual Excellence in Research Award, Faculty of Arts and Sciences, Tulane University, 1985; Member: AMS, AWM, MAA, Edinburgh Mathematical Soci-

ety; Institute of Mathematical Statistics, Sigma Xi, Sociedade Matematica Brasileira, London Mathematical Society; served on various committees of the MAA and SIAM and on three editorial boards of research journals.

Selected Publications: 1. with H. Brezis, *Liouville theorems for some improperly posed problems*, Improperly Posed Boundary Value Problems (A. Carasso and A. P. Stone, eds.), Res. Notes in Math., vol. 1, Pitman, London (1975), 65–75. MR **57** #16883; 2. with James T. Sandefur, Jr., *Equipartition of energy for higher order abstract hyperbolic equations*, Comm. Partial Differential Equations **7** (1982), 1217–1251. MR **83k**:34060; 3. with Pierre Baras, *The heat equation with a singular potential*, Trans. Amer. Math. Soc. **284** (1984), 121–139. MR **85f**:35099; 4. *Semigroups of linear operators and applications*, Oxford Univ. Press, New York and Oxford, 1985; 5. with Philippe Bérnilan and Gisèle Ruiz Rieder, *A nonlinear elliptic system arising in electron density theory*, Comm. Partial Differential Equations, to appear.

Statement: The business of the AMS is to promote mathematical activity and scholarship at the highest levels. High standards should be maintained while avoiding elitism. All qualified and interested individuals should be encouraged to pursue careers in mathematics and to advance their careers as far as possible. These positions imply advocacy of affirmative action, concern for the welfare of individual mathematicians, concern over educational issues, and advocacy for research support for larger numbers of mathematicians.

Vaughan F. R. Jones

Professor, University of California, Berkeley

Born: December 31, 1952, Gisborne, New Zealand

Ph.D.: Université de Geneve, Switzerland, 1979

AMS Committees: Committee on Steele Prizes, 1992.

Selected Addresses: Special Session on C^* -Algebras, Reno, April 1981; Invited Address, Amherst, October 1985; Special Session on Braids, Links, and Operator Algebras, Amherst, October

1985; International Congress of Mathematicians, 1986; Invited Address, AMS Centennial, Providence, 1988; Plenary Address, International Congress of Mathematicians, 1990.

Additional Information: Sloan Fellow, 1983; Guggenheim Fellow, 1986; Fields Medal, 1990; Executive Committee, International Association of Mathematical Physics.

Selected Publications: 1. *Actions of finite groups on the hyperfinite type II_1 factor*, Mem. Amer. Math. Soc. **28** (1980), no. 237. MR **81m**:46094; 2. *Index for subfactors*, Invent. Math. **72** (1983), 1–25. MR **84d**:46097; 3. *A polynomial invariant for knots via von Neumann algebras*, Bull. Amer. Math. Soc. **12** (1985), 103–111. MR **86e**:57006; 4. *On knot invariants related to some statistical mechanical models*, Pacific J. Math. **137** (1989), 311–334. MR **89m**:57005.

Statement: With a background in functional analysis, I am interested in the rich interplay between various branches of mathematics, physics and biology. I see such work as vital for the health of mathematics, while not failing to appreciate the value of singled-minded dedication to a difficult problem in a specific area.

Brian J. Parshall

Professor of Mathematics, University of Virginia

Born: October 28, 1945 in Penn Yan, New York

Ph.D.: Yale University, 1971

AMS Committees: Committee on Summer Institutes and Special Symposia, 1989–; Chair, Committee on Summer Institutes and Special Symposia, 1991–1993.

Selected Addresses: Invited Address, Michigan State University, March 1988; Special Session on Quantum Groups and Finite Dimensional Algebras, Penn State University, April 1990.

Additional Information: Organizing Committees: (1) AMS Summer Research Conference on Finite and Algebraic Groups: Modular Representations and Cohomology, Arcata, July 1989; (2) MSRI Workshop on Representation Theory of Reductive Groups, November 1990; (3) AMS Summer Research Insti-

tute on Algebraic Groups, July 1991; (4) Yale Conference on Lie Algebras, April 1992.

Selected Publications: 1. with E. Friedlander, *Support varieties for restricted Lie algebras*, Invent. Math. **86** (1986), 553–562. MR **88f**:17018; 2. with E. Cline and L. Scott, *Finite dimensional algebras and highest weight categories*, J. Reine Angew. Math. **391** (1988), 85–99. MR **90d**:18005; 3. *Finite dimensional algebras and algebraic groups*, Contemp. Math. **82**, Amer. Math. Soc., Providence, RI, 1989, pp. 97–114. MR **90j**:20091; 4. with E. Friedlander, *Induction, deformation, and specialization of Lie algebra representations*, Math. Ann. **290** (1991), 473–489; 5. with Jian-pan Wang, *Quantum linear groups*, Mem. Amer. Math. Soc. **439** (1991). MR **91g**:16028.

Statement: The American Mathematical Society should aim to promote mathematics in general and mathematical research in particular. Besides through its publications and meetings, it can realize these goals in a number of important ways: by providing meaningful aid to young mathematicians in hard times, by strengthening contacts with other sciences, by aggressively influencing funding agencies (and by coming up with new sources of money), and by educating the public on the importance of mathematics in society. If elected to the Nominating Committee, I will support people with these objectives in mind.

Louise A. Raphael

Professor, Howard University

Born: October 24, 1937, New York, NY

Ph.D.: Catholic University, 1967

AMS Committees: AMS-MAA-SIAM Congressional Science Fellowship Selection Panel, 1985–1986; Liaison Committee on Education in Mathematics, 1989–; Liaison Committee with AAAS, 1992–.

Selected Addresses: Special Session on Summability and Related Topics, Biloxi, January 1979 and Cincinnati, January 1982; Special Session on Partial Differential Equations, Theory and Application, San Luis Obispo, November 1983; Special Session on Analytic Methods in Differential Equations, New

Orleans, January 1986; Special Session on Hopf Algebras, San Francisco, January 1991.

Additional Information: NSF Summer Fellow, 1963–1964; NASA Fellow, 1965–1966; Visiting Positions: MIT, Visiting Associate Professor, 1977–1978 and Visiting Professor, 1989–1990; University of California at Berkeley, Henkin/Treisman's Summer Institute Mathematics Faculty, 1990. Member: AMS, AWM, MAA, NAM, NCTM, SIAM, ΣX .

Selected Publications: 1. with Mark Kon and James Young, *Kernels and equisummation properties of uniformly elliptic operators*, J. of Differential Equations **67** (1987), 256–268. MR **88b**:35143; 2. with Charles Chui and Harvey Diamond, *Interpolation by multivariate splines*, Math. Comp. **51** (1988), no. 183, 203–218. MR **89j**:41002; 3. with Robert Carroll, *Some inverse problems with spectral limitations on data*, SIAM J. Appl. Math. **48** (1988), no. 5, 1194–1205. MR **89k**:35248; 4. with Philip S. Hirschhorn, *Coalgebraic foundations of the method of divided differences*, Adv. Math. **91** (1992), no. 1, 75–135; 5. with Harvey Diamond and Daniel Williams, *Box-spline-based approach to the formulation of numerical methods for partial differential equations*, Numer. Methods Partial Differential Equations **8** (1992), 291–301.

Statement: I will recommend the best qualified mathematicians, with special care to promote the candidacies of women and minorities for AMS offices, council, committees, and boards in order to ensure that the AMS has the benefit of the best mathematical talent and wisdom of all its members.

Yum-Tong Siu

Professor, Harvard University

Born: May 6, 1943, Canton, China

Ph.D.: Princeton University, 1966

AMS Committees: Committee to Select Hours Speakers for Eastern Section Meetings, 1983–1984.

Selected Addresses: International Congress of Mathematicians, Helsinki, 1978 and Warsaw, 1983. Invited Address, Atlanta, January 1978; CBMS Regional Conference, Charleston, Illinois, August 1988.

Additional Information: Sloan Fellow, 1971-1973; Gauss Professor, Göttingen Academy of Sciences, 1980; Chair, Organizing Committees: Symposium on Several Complex Variables, Madison, April 1982; Summer Research Conference on Complex Differential Geometry and Nonlinear Differential Equations, Brunswick, August 1984; Member, Committee on Mathematics, National Academy of Sciences, 1985; Guggenheim Fellow, 1985-1986; Chair, Panel to Select Speakers for the Complex Analysis Section of the International Congress of Mathematicians, 1986; Editor: *Journal of Differential Geometry*, 1986-1989.

Selected Publications: 1. *A Hartogs type extension theorem for coherent analytic sheaves*, Ann. of Math. (2) **93** (1971), 166-188. MR **43** #5064; 2. *Analyticity of sets associated to Lelong numbers and the extension of closed positive currents*, Invent. Math. **27** (1974), 53-156; 3. *The complex-analyticity of harmonic maps and the strong rigidity of compact Kaehler manifolds*, Ann. of Math. (2) **112** (1980), 73-111. MR **81j**:53061; 4. *Every K3 surface is Kaehler*, Invent. Math. **73** (1983), 139-150. MR **84j**:32036; 5. *Global nondeformability of the complex projective space*, (Proc. the 25th Taniguchi Colloquium in Katata, Japan, 1989), J. Noguchi and T. Ohsawa (Editors), Lecture Notes in Math., vol. 1468, Springer, Berlin-New York, 1991, pp. 254-280.

Nancy K. Stanton

Professor, University of Notre Dame

Born: March 23, 1948, San Francisco, California

Ph.D.: Massachusetts Institute of Technology, 1973

AMS Committees: Committee to Select Hour Speakers for Central Section Meetings, 1986-1987 (Chair, 1987); Committee on Research Fellowships, 1987-1988; Notices Editorial Committee, 1987-1990; Program Committee for National Meetings, 1991- (Chair, 1992); AMS-MAA Joint Program Committee for the 1992 Baltimore Meeting, 1991 (Chair); AMS-CMS Joint Program Committee, 1991- ; Ad Hoc Meetings Committee, 1992.

Selected Addresses: Invited Address, Bryn Mawr, March 1982; Special Session on Geometry and Analysis on CR Manifolds, Salt Lake City, August 1987; Summer Research Institute on Several Complex Variables, Santa Cruz, July 1989; MAA Invited Address, Boulder, August 1989; Summer Research Institute on Differential Geometry, Los Angeles, July 1990.

Additional Information: Member, Institute for Advanced Study, 1979-1980; Sloan Fellow, 1981-1985; Visitor, Institut des Hautes Etudes Scientifiques, 1982-1983; Gastprofessor, Max Planck Institut für Mathematik, 1983; Organizing Committee, Symposium on Pseudodifferential Operators and Fourier Integral Operators with Applications to Partial Differential Equations, Notre Dame, April 1984; AMS Representative, Evaluation Panel for NSF Postdoctoral Research Fellowships, 1984-1990 (AMS Representative, Executive Committee, 1990); NSF Ad Hoc Panel on Quick Response Research Grants, 1989; MAA Representative, Selection Panel for Presidential Awards for Excellence in Science and Mathematics Teaching, 1990; Member: AMS, AWM, MAA, NCTM.

Selected Publications: 1. with David S. Tartakoff, *The heat equation for the $\bar{\partial}_b$ -Laplacian*, Comm. Partial Differential Equations **9** (1984), 597-686. MR **85f**:58114; 2. with Richard Beals and Peter C. Greiner, *The heat equation on a CR manifold*, J. Differential Geom. **20** (1984), 343-387. MR **86g**:58135; 3. with Richard Beals, *The heat equation for the $\bar{\partial}$ -Neumann problem*. I. Comm. Partial Differential Equations **12** (1987), 351-413. MR **89b**:58199; II. Canadian J. Math. **40** (1988), 502-512. MR **89e**:58112; 4. *A normal form for rigid hypersurfaces in C^2* , American J. Math. **113** (1991), 877-910; 5. *Infinitesimal CR automorphisms of rigid hypersurfaces in C^2* , J. Geometric Analysis **1** (1991), 231-267.

Statement: The mission of the AMS is "to further the interests of mathematical research and scholarship," broadly construed. The recent report of the Strategic Planning Task Force articulates a broad vision of the goals of the AMS in fulfilling its mission over the next few years.

This must be done without enlarging the Society's bureaucracy and without making the Society increasingly impersonal. I would try to find candidates who reflect the diversity of the Society's membership, who have a broad view of mathematics, and who have the creativity to help the Society meet its goals. In particular, candidates should be sensitive to critical issues involving mathematics research and support for research, mathematics education, employment for mathematicians, increased participation of underrepresented groups, and public awareness of mathematics.

Editorial Boards Committee

Bryan J. Birch

Professor, University of Oxford

Born: September 25, 1931, Burton-on-Trent, England

Ph.D.: Cambridge University, 1957

Selected Addresses: Symposium on Number Theory, Pasadena, November 1963; International Congress of Mathematicians, Moscow 1963.

Additional Information: Delegate of Oxford University Press; Editor of *Topology*; Formerly on editorial boards of *Inventiones Mathematicae*, of the *Journal of Number Theory*, and of the journals of the London Mathematical Society; Fellow of the Royal Society; Member: AMS, the Fachbeirat of the Max-Planck-Institut in Bonn, and the Beirat of the Institut für Experimentelle Mathematik in Essen.

Selected Publications: 1. *Forms in many variables*, Proc. Royal Soc. Ser. A **265** (1962), 245-263. MR **27** #132; 2. with H.P.F. Swinnerton-Dyer, *Notes on elliptic curves*, I. J. Reine Angew. Math. **212** (1963), 7-25. MR **26** #3669; 3. with H.P.F. Swinnerton-Dyer, *Notes on elliptic curves*. II. J. Reine Angew. Math. **218** (1965), 79-108. MR **31** #3419; 4. edited with W. Kuyk, *Modular Functions of One Variable*. IV. Lecture Notes in Math., vol. 476, Springer-Verlag, Berlin-New York, 1975. MR **51** #12708; 5. with N. M. Stephens, *Computation of Heegner Points*, Modular Forms (Durham Symposium, 1983), pp. 13-41, Ellis Horwood Ser. Math. Appl.: Statist. Oper. Res., Horwood, Chichester, 1984. MR **87f**:11036a.

Statement: As mathematicians, we are fortunate that our community is an international one, in which cooperation has always been possible; and we must be glad that collaboration has become easier.

Fan R. K. Chung

Bellcore Fellow, Visiting Professor at Harvard University

Born: October 9, 1949, Taiwan

Ph.D.: University of Pennsylvania, 1974

Offices: Member-at-Large of the Council, 1989–1992.

AMS Committees: AMS-IMS-SIAM Committee on Joint Summer Research Conferences in the Mathematical Sciences, 1990–.

Selected Addresses: Invited Address, First China-USA Graph Theory Conference, Jinan, China 1986; Invited Address, Second Japan Conference on Graph Theory, Combinatorics and Computing, Hakone, Japan 1986; AMS-MAA Invited Address, Orono, August 1991; Invited Address, Washington, DC, April 1993.

Additional Information: Allendoerfer Award, 1990.

Selected Publications: 1. *Diameters and eigenvalues*, J. Amer. Math. Soc. **2** (1989), 187–196. MR **89k**:05070; 2. *Sphere-and-point incidence relations in high dimensions with applications to unit distances and furthest neighbor pairs*, Discrete Comput. Geom. **4** (1989), 183–190. MR **90g**:52011; 3. *Universal graphs and induced-universal graphs*, J. Graph Theory **14** (1990), 443–454; 4. with Ronald Graham, *Quasi-random set systems*, J. Amer. Math. Soc. **4** (1991), 151–196. MR **91m**:05138; 5. *Constructing random-like graphs*, Proc. Sympos. Appl. Math., vol. **44**, Amer. Math. Soc., Providence, RI, pp. 21–56.

Statement: We are today in the midst of a technological revolution. Mathematics will play a vital role both in laying the foundation for this process and in

making crucial contributions throughout the whole spectrum of this development. The AMS, as the major organization for fostering mathematics research, has a special responsibility to maximize the impact of mathematicians and to attract the best talent, including, in particular, women and minorities. The publication program of the AMS is a primary vehicle by which it serves its members as well as the world mathematical community. It is therefore important that editorial boards of the AMS journals reflect the broad spectrum of AMS members and their interests.

Paul H. Rabinowitz

Professor, University of Wisconsin, Madison

Born: November 15, 1939, Newark, New Jersey

Ph.D.: New York University, 1966

AMS Committees: *Transactions and Memoirs* Editorial Committee, 1980–1983; Committee on Postdoctoral Fellowships, 1981–1983; Committee on the 1983 AMS-SIAM Summer Institute on Nonlinear Functional Analysis and its Applications; AMS-MAA Joint Committee for the New Orleans Meeting, 1986; Committee on Committees, 1986–1988; Program Committee for National Meetings, 1986–1988 (Chair, 1987–1988); AMS-MAA Joint Program Committee for the Atlanta Meeting, 1987; AMS-MAA Joint Program Committee for the Salt Lake City Meeting, 1987 (Chair); *Journal of the AMS* Editorial Committee (Associate Editor), 1987–1991; Committee on the Internal Organization of the American Mathematical Society, 1988; Committee on Summer Institutes and Special Symposia, 1988–1989; Committee on Progress in Mathematics, 1989–1990.

Selected Addresses: Special Session on Nonlinear Functional Analysis, St. Louis, April 1975; Special Session on Functional Analytical Methods for Non-

linear Partial Differential Equations, San Antonio, January 1976; Special Sessions on Partial Differential Equations, Albuquerque, November 1976 and Madison, April 1982; International Congress of Mathematicians, 1978; Invited Address, Kent, November 1979; Colloquium Lectures, Eugene, August 1984.

Additional Information: Guggenheim Fellow, 1978; Member: AMS.

Masamichi Takesaki

Professor of Mathematics, University of California, Los Angeles

Born: July 18, 1933, Sendai, Japan

Ph.D.: Tohoku University, 1965

Selected Addresses: International Congress of Mathematicians, Nice, 1970; Invited Address, San Francisco, January 1982; Principal Lecturer, CBMS Regional Conference, University of Iowa, April 1982; Summer Research Institute on Operator Theory/Operator Algebras and Applications, Durham, July 1988.

Additional Information: Sakkokai Fellow, 1964–1967; Guggenheim Fellow, 1973–1974; Fujiwara Prize, June, 1990; Member: AMS, International Association of Mathematical Physics; Mathematical Society of Japan.

Selected Publications: 1. *Tomita's theory of modular Hilbert algebras and its applications*, Lecture Notes in Math., vol. 128, Springer-Verlag, Berlin-New York, 1970. MR **42** #5061; 2. *Duality for crossed products and the structure of von Neumann algebras of type III*, Acta Math. **131** (1973), 249–310. MR **55** #11068; 3. with A. Connes, *The flow of weights on factors of Type III*, Tohoku Math. J. **29** (1977), 473–575. MR **82a**:46069a; 4. *Theory of operator algebras*. I. Springer-Verlag, New York-Heidelberg, 1979. MR **81e**:46038; 5. *Structure of factors and automorphism groups*, CBMS Regional Conference Series in Mathematics, vol. 51, Amer. Math. Soc., Providence, RI, 1983. MR **84k**:46043.

Dayton, Ohio

Wright State University

October 30–November 1, 1992

Second Announcement

The eight-hundred-and-seventy-sixth meeting of the American Mathematical Society (AMS) will be held at Wright State University, Dayton, Ohio, on Friday, October 30, Saturday October 31, and Sunday, November 1, 1992. Invited addresses will be in the auditorium of the Medical Sciences Building; sessions will be held in the Russ Engineering Center and in Rike Hall.

Invited Addresses

By invitation of the Central Section Program Committee, there will be four invited one-hour addresses. The speakers, their affiliations, and the titles of their talks are:

Martin Golubitsky, University of Houston, *Symmetry and chaos*.

Jonathan I. Hall, Michigan State University, *Finite methods in infinite groups and discrete geometries*.

Louis H. Kauffman, University of Illinois at Chicago, *From knots to quantum field theory and back*.

J. Toby Stafford, University of Michigan, Ann Arbor, *Noncommutative graded algebras and projective geometry*.

Special Sessions

By invitation of the same committee, there will be twelve special sessions of selected twenty-minute papers. The topics of these sessions, and the names and affiliations of the organizers, are as follows:

Hyperbolic manifolds, **Colin C. Adams**, Williams College, and **Ara S. Basmajian**, University of Oklahoma.

Quantum groups and regular algebras, **Carolyn A. Dean**, University of Michigan, Ann Arbor, **Timothy J. Hodges**, University of Cincinnati, and **J. Toby Stafford**.

Operator theory and operator algebras, **Joanne M. Domrowski** and **Richard Mercer**, Wright State University.

Combinatorics and graph theory, **Anthony B. Evans** and **Terry A. McKee**, Wright State University.

Groups and geometries, **Daniel E. Frohardt**, Wayne State University.

Control theory and partial differential equations, **Lop Fat Ho**, Wright State University, **Srdjan D. Stojanovic**, University of Cincinnati, and **Thomas Svobody**, Wright State University.

Differential and integral equations, **Muhammad N. Islam**, University of Dayton, and **Lawrence Turyn**, Wright State University.

Knots and topological quantum field theory, **Louis H. Kauffman**.

Riccati equations and transport theory, **Hendrik J. Kuiper**, Arizona State University, and **Tapas Mazumdar**, Wright State University.

Topology of affine hypersurfaces and related number theory, **Anatoly S. Libgober**, University of Illinois at Chicago, and **Steven Sperber**, University of Minnesota, Minneapolis.

Set-theoretic topology, **Joe D. Mashburn**, University of Dayton.

Function theory, **C. David Minda**, University of Cincinnati.

Abstracts for consideration for these sessions should have been submitted by the **July 13, 1992** deadline. This deadline was previously published in the Calendar of AMS Meetings and Conferences and in the Invited Speakers and Special Sessions section of the *Notices*.

Contributed Papers

There will also be sessions for contributed ten-minute papers. Abstracts for consideration of these sessions should have been submitted by the **August 3, 1992** deadline previously published in the Calendar of AMS Meetings and Conferences. Late papers will not be accommodated.

Registration

The meeting registration desk will be located in the first floor lobby of the Russ Engineering Center. The registration desk will be open from 12:30 p.m. to 5:00 p.m. on Friday, October 30; and 8:00 a.m. to 3:00 p.m. on Saturday, October 31. The registration fees are \$30 for members of the AMS, \$45 for nonmembers, and \$10 for students or unemployed mathematicians.

Accommodations

Rooms have been blocked for participants at the Holiday Inn (Fairborn I-165 location), Homewood Suites, and the Red

Roof Inn (Fairborn location), located just south of the street (Colonel Glenn Highway) that borders the south edge of the Wright State Campus. Rooms have also been blocked at the Ramada Inn (Fairborn location), and the Comfort Inn Wright-Patterson in central Fairborn. Participants should make their own arrangements with the hotel of their choice and ask for the AMS conference rate.

Fairborn is a suburb of Dayton and most lodgings are chains with other locations in the metropolitan Dayton area. Thus, participants are advised to verify the street address of the lodging when making reservations. All rates are subject to a twelve percent tax. **The AMS is not responsible for rate changes or the quality of the accommodations offered by these hotels/motels.**

Comfort Inn Wright-Patterson (5 miles from Russ Engineering Center)

616 North Broad Street, Fairborn, OH 45324

Telephone: 513-879-7666 or 800-245-3127

The deadline for reservations is October 16, 1992.

Single \$39

Double \$43

Holiday Inn Fairborn I-675 (0.4 miles from Russ Engineering Center)

2800 Presidential Drive, Fairborn, OH 45324

Telephone: 513-426-7800 or 800-465-4329

The deadline for reservations is October 9, 1992.

Flat rate \$63 up to four occupants

Please note: The previously published rate was incorrect. We regret any inconvenience this may have caused.

Homewood Suites (0.5 miles from Russ Engineering Center)

2750 Presidential Drive, Fairborn, OH 45324

Telephone: 513-429-0600 or 800-225-5466

The deadline for reservations is October 9, 1992.

Flat rate \$69

Suite with king bed, sleeper sofa (four occupants)

Ramada Inn (5 miles from Russ Engineering Center)

800 North Broad Street, Fairborn, OH 45324

Telephone: 513-879-3920 or 800-272-6232

The deadline for reservations is October 16, 1992.

Single or double occupancy \$42

Red Roof Inn - Fairborn, #205 (.7 miles from Russ Engineering Center)

2580 Colonel Glenn Highway, Fairborn, OH 45324

Telephone: 513-426-6116 or 800-874-9000

The deadline for reservations is October 20, 1992

When making reservations participants should mention the following confirmation number: 205AA92304.

Single \$35.99 Double \$42.99 Triple \$45.99

Food Service

The cafeteria in the University Center (a convenient walk from the buildings in which the meeting will held) will be open

for breakfast, lunch, and dinner on Friday, October 30, and for brunch and dinner on Saturday, October 31 and Sunday, November 1. Several restaurants and fast food establishments are located adjacent to the Wright State campus. Some of these are convenient to the buildings in which the meeting will be held; others are close to the Holiday Inn Fairborn, the Homewood Suites, or the Red Roof Inn-Fairborn. Likewise, other restaurants and fast food establishments are located in downtown Fairborn, near the Comfort Inn Wright-Patterson or the Ramada Inn.

Parking

Free parking will be available to participants throughout the meeting. On the afternoon of Friday, October 30, participants should park in the PE Lot located southwest of the Russ Engineering Center. From Friday night through Sunday afternoon, participants may park in essentially all campus lots (excepting those spaces marked as reserved). The most convenient will be FW Lot, Health Sciences Lot, Biological Sciences Lot, Rike Lot, Visitor Lot, Allyn Lot, and PE Lot. These lots are shown on the campus map, as are the buildings in which the sessions will be held: Russ Engineering Center (RC on the map), Rike Hall (R), and Medical Sciences Building (MS).

Travel and Local Information

Arriving by air: Dayton International Airport is served by several major airlines. Car rental agencies are located in the airport terminal. Ground transportation is available by Dayton Yellow Cab (513-228-1155) and Charter Vans, Inc. (513-898-4043 or 898-7171). The airport is approximately a thirty-minute drive from the campus. Rental car companies are located in the airport terminal.

Arriving by car: The principal highways through the Dayton metropolitan area are I-70, I-75, and US Route 35. Participants arriving from the north of Dayton on I-75 should take I-75 South to I-70 East, then Ohio Route 4 South to Ohio Route 444 North to Kauffman Avenue.

Participants arriving from south of Dayton on I-75 should take I-75 North to I-675 North and exit at the North Fairfield Road exit (exit 17). Turn left on North Fairfield and left on Colonel Glenn Highway. (Alternatively, at exit 17 one may take 444A and follow it to the Wright State exit).

Participants arriving from east of Dayton on I-70 should take I-70 West to I-675 South and exit at North Fairfield Road (exit 17). Turn right on North Fairfield and left on Colonel Glenn Highway.

Participants arriving from east of Dayton on US 35 should take US 35 West and exit onto I-675 North. On I-675 North, exit at the North Fairfield Road exit (exit 17) and turn left on North Fairfield and left on Colonel Glenn Highway. (Alternatively, at exit 17 one may take 444A and follow it to the Wright State exit).

Participants arriving from west of Dayton on I-70 should take I-70 East to Ohio Route 4 South to Ohio Route 444 North to Kauffman Avenue.

Meetings

Participants arriving from west of Dayton on US 35 should take US 35 East to I-675 North to the North Fairfield Road exit (exit 17). Turn left on North Fairfield and left on Colonel Glenn Highway. (Alternatively, at exit 17 one may take 444A and follow it to the Wright State exit).

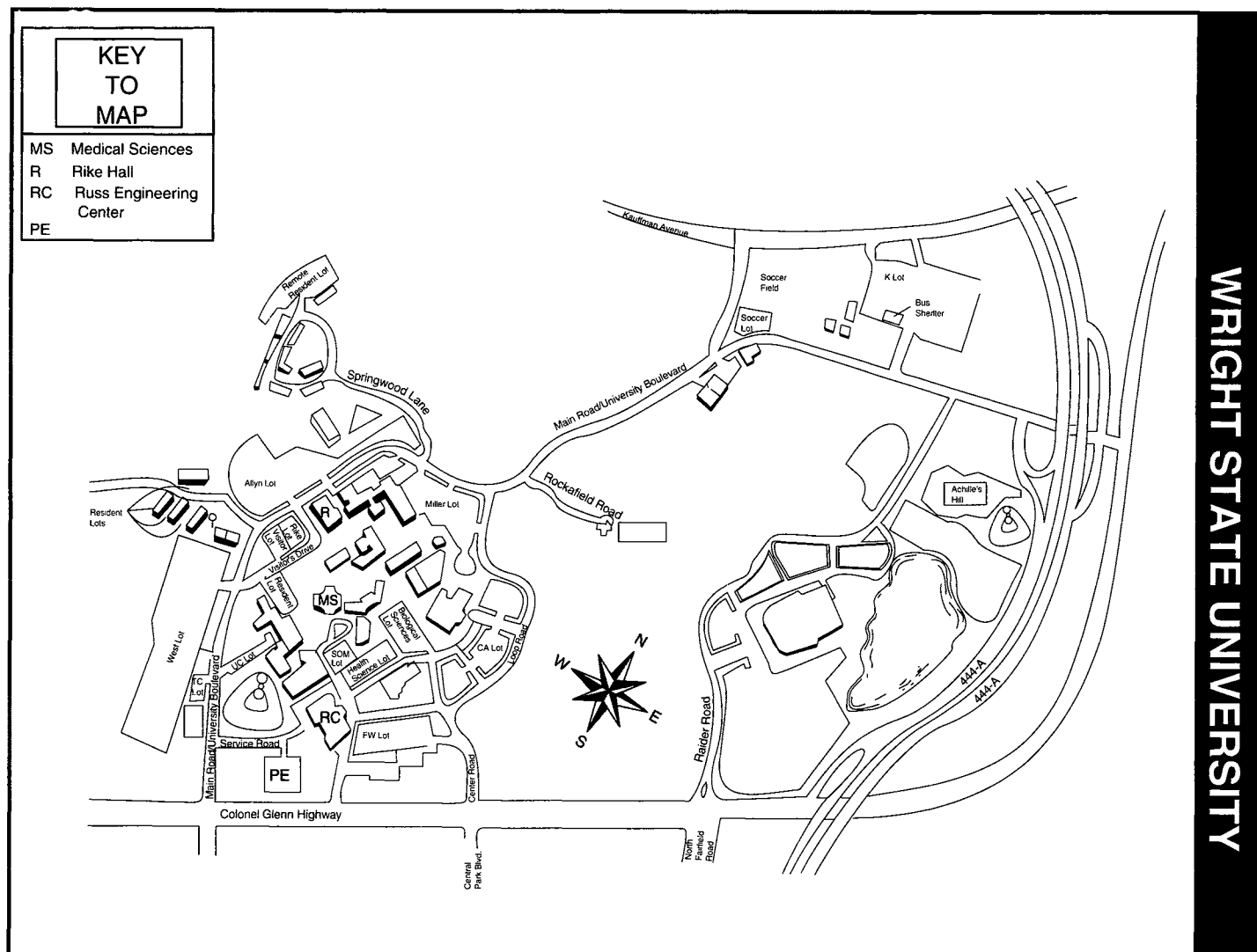
Ohio Route 4 may be under construction when this meeting occurs. Therefore, participants arriving by car from north of Dayton on I-75 or from west of Dayton on I-70 should be prepared to alter the directions above as follows: follow I-70 East; skip the exit at Ohio Route 4 and continue on I-70 East to I-675 South and exit at North Fairfield Road (exit 17). Turn right on North Fairfield and left on Colonel Glenn Highway.

is the United States Air Force Museum, approximately a ten-minute drive from campus. This is the largest military aviation museum in the world. Admission is free. The museum is open from 9:00 a.m. to 5:00 p.m. every day. Exhibits include about two hundred aircraft and missiles, many other displays of related historical artifacts, and free documentary films. For a \$4 admission, one can also view films in the huge-screen IMAX Theater. Rounding out the facility are a book shop, gift store, and cafe.

Andy R. Magid
Associate Secretary
Norman, Oklahoma

Weather and Local Attractions

The average temperatures in Dayton for early November are 57-58°F (high) and 38-39°F (low). The closest local attraction



Los Angeles, California

University of Southern California

November 7–8, 1992

Second Announcement

The eight-hundred-and-seventy-seventh meeting of the American Mathematical Society (AMS) will be held at the University of Southern California (USC) on Saturday, November 7, and Sunday, November 8, 1992. This meeting will take place concurrently with a meeting of the Southern California section of the Mathematical Association of America (MAA). The invited addresses will be held in the Seeley G. Mudd Building, one block east of the Denny Building, and most other sessions will be held in Kaprielian Hall, north across 36th Place from the Denny Building.

Invited Addresses

By invitation of the Western Section Program Committee, there will be three invited addresses. The speakers, their affiliations, and the titles of their talks are:

Robert L. Lazarsfeld, University of California, Los Angeles, *Syzygies of algebraic varieties*.

Tomasz S. Mrowka, California Institute of Technology, *Gauge theory and embedded surfaces*.

Thomas C. Sideris, University of California, Santa Barbara, *The life span of 3D compressible and incompressible flow*.

Special Sessions

By invitation of the same committee, there will be eight special sessions of selected twenty-minute papers. The topics of these sessions, and the names and affiliations of the organizers, are as follows:

Finite and algebraic groups, **Michael Aschbacher**, California Institute of Technology, **Robert M. Guralnick**, University of Southern California, and **David B. Wales**, California Institute of Technology.

Spectral Geometry, **Robert Brooks**, University of Southern California, and **Peter A. Perry**, University of Kentucky.

Hyperbolic geometry, **Francis Bonahon** and **Robert Meyerhoff**, University of Southern California.

Algebraic and complex geometry, **Lawrence Ein**, University of Illinois at Chicago.

Dynamical systems, **Eugene Gutkin** and **Nicolai T. A. Haydan**, University of Southern California.

Gauge theory and four manifolds, **Tomasz S. Mrowka**.

Topics in geometry and physics, **Robert C. Penner**, University of Southern California, and **Edward Witten**, School of Natural Science, IAS.

Nonlinear hyperbolic PDE and fluid mechanics, **Gustavo Ponce**, University of California, Santa Barbara, and **Thomas C. Sideris**.

Abstracts for consideration for these sessions should have been submitted by the **July 13, 1992** deadline. This deadline was previously published in the Calendar of AMS Meetings and Conferences and in the Invited Speakers and Special Sessions section of the *Notices*.

Contributed Papers

There will also be sessions for contributed ten-minute papers. Abstracts for consideration of these sessions should have been submitted by the **August 3, 1992** deadline previously published in the Calendar of AMS Meetings and Conferences. Late papers will not be accommodated.

Registration

The meeting registration desk will be located in the lobby of the Denny Research Center, on the southeast corner of Vermont Avenue and 36th Place, and will be open on Saturday, November 7, from 7:30 a.m. to 5:00 p.m. and on Sunday, November 8, from 7:30 a.m. to noon. The registration fees are \$30 for members of the AMS, \$45 for nonmembers, and \$10 for students or unemployed mathematicians.

Accommodations

Rooms have been blocked for participants at the University Hilton hotel located across from the university on Figueroa Street at Exposition Boulevard. Participants should make their own reservations directly with the hotel, and participation in the AMS-MAA meeting should be mentioned to receive the special rates quoted below. **The AMS is not responsible for rate changes or the quality of the accommodations offered by these hotels/motels.**

University Hilton

3540 South Fugueo Street
Los Angeles, CA 90007

Meetings

Telephone: 213-748-4141
800-244-7331 (within California)
800-872-1104 (outside California)

Single \$70 Double \$75

Food Service

On campus facilities include the Commons Cafeteria, located in the Commons Building, open on Saturday from 9:00 a.m. to 5:00 p.m.; Carl's Junior, located south of the Commons Building, open on Saturday from 9:00 a.m. to 5:00 p.m. and on Sunday from 11:00 a.m. to 5:00 p.m.; and Cafe 84, located in the Frank L. King Hall, open on Saturday from 11:00 a.m. to 8:00 p.m., and on Sunday from 11:00 a.m. to 11:00 p.m. Cafe 84 has a soup, sandwich, and salad bar, as well as a grill, pizza, pasta, pastries, and ice cream. In addition to the restaurant in the University Hilton, several chains have outlets on Figueroa Street.

Parking

Parking permits are required and cost \$5 per day. Participants should park in Parking Structure A and note that the west end of Structure A is closest to the registration area. There are stairwells at each corner of the building, although the only elevator in Structure A is at the northeast corner.

Travel

The campus is located about four miles south of downtown Los Angeles near the intersection of the Santa Monica Freeway

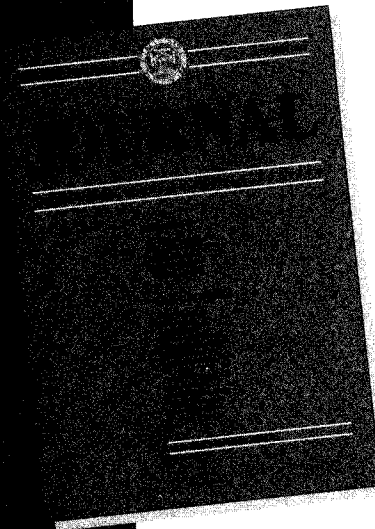
(10) and the Harbor Freeway (110). Shuttle service is readily available from the Los Angeles International Airport to the campus. The fare for the "Super Shuttle" (limo service) from the airport to the University Hilton is \$12 per person, each way. To reach the campus by car, exit the Harbor Freeway (110) at Exposition Boulevard. The Hilton is on the right at Figueroa Street, and Main Entrance I to the university is approximately one-quarter mile farther down Exposition Boulevard, at Hoover Street.

Weather and Local Information

The average high temperature in Los Angeles in the month of November is 73°F, and the average low temperature is 52°F. Rain is possible, but not very likely. Hot weather of approximately 90°F is also possible at this time of year. The city of Los Angeles and the surrounding area have many worthwhile museums and other interesting attractions. Those closest to campus are the Los Angeles County Museum of Science and Industry, and the Museum of Natural History located directly opposite the campus, across Exposition Boulevard. The Natural History Museum has recently opened the third largest live insect zoo in the nation, and also has a Discovery Center of hands-on exhibits for children. The Science and Industry Museum runs IMAX theater presentations. Use of the pool and gym at the Lyon University Center is possible by presenting a meeting badge and a \$5 entry fee.

Lance W. Small
Associate Secretary
La Jolla, California

Journal of the American Mathematical Society



When the *Journal of the American Mathematical Society* first appeared in 1988, it gained instant respect for its careful selection of relevant, important, and timely research. The editors are devoted to publishing research articles of the highest quality in all areas of pure and applied mathematics. Editors of this journal include: H. Blaine Lawson, Jr., Robert D. MacPherson, Richard Melrose, Andrew Odlyzko, and Wilfried Schmid.

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Invited Addresses and Special Sessions

Invited Addresses at AMS Meetings

The individuals listed below have accepted invitations to address the Society at the times and places indicated. For some meetings, the list of speakers is incomplete. Invited addresses at Sectional Meetings are selected by the Section Program Committee, usually twelve to eighteen months in advance of a meeting. Members wishing to nominate candidates for invited addresses should send the relevant information to the Associate Secretary for the Section who will forward it to the Section Program Committee.

Dayton, OH, October 1992

Please see the second announcement of this meeting elsewhere in this issue.

Los Angeles, CA, November 1992

Please see the second announcement of this meeting elsewhere in this issue.

San Antonio, TX, January 1993

George E. Andrews (AMS-MAA)	Robert Osserman (AMS-MAA)
Richard A. Brualdi (AMS-MAA)	Charles S. Peskin (Gibbs Lecture)
Luis A. Caffarelli (Colloquium Lectures)	Bernd Sturmfels
Jim Douglas, Jr.	Leon Takhtajan
Carolyn S. Gordon	Alexander Varchenko
Wu-Yi Hsiang	Mary F. Wheeler (AMS-MAA)

Knoxville, TN, March 1993

Paul R. Blanchard	Richard A. Tapia
Olav Kallenberg	Michelle L. Wachs

Washington, DC, April 1993

Fan R. K. Chung	Joel Spruck
Leopold Flatto	A. Zamolodchikov

Dekalb, IL, May 1993

Susan J. Friedlander	Clark Robinson
Russell D. Lyons	

Vancouver, British Columbia, Canada August 1993

Louis Nirenberg (AMS-CMS)	Jill Pipher (AMS-CMS)
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College Station, TX, October 1993

Steven P. Lalley	Stephan A. Stolz
Gilles Pisier	

Organizers and Topics of Special Sessions

The list below contains all the information about Special Sessions at meetings of the Society available at the time this issue of the *Notices* went to the printer. The section below entitled **Information for Organizers** describes the timetable for announcing the existence of Special Sessions.

October 1992 Meeting in Dayton, Ohio Central Section

Associate Secretary: Andy R. Magid

Deadline for organizers: Expired

Deadline for consideration: Expired

Please see the second announcement of this meeting elsewhere in this issue.

November 1992 Meeting in Los Angeles, California Western Section

Associate Secretary: Lance W. Small

Deadline for organizers: Expired

Deadline for consideration: Expired

Please see the second announcement of this meeting elsewhere in this issue.

January 1993 Meeting in San Antonio, Texas

Associate Secretary: W. Wistar Comfort

Deadline for organizers: Expired

Deadline for consideration: September 17, 1992

Kathleen T. Alligood and Judy A. Kennedy, *Continuum theory and dynamical systems*

Thomas Archibald and Victor Katz, *History of mathematics*
 Alvaro Arias, *Banach space theory*
 Charles E. Aull, *History of general topology*
 Melvyn S. Berger and Daniel Goroff, *Small divisor problems in nonlinear analysis*
 Scott T. Chapman, *Commutative algebra*
 William J. Coles and B. A. Fusaro, *Environmental modeling*
 David Cox and Bernd Sturmfels, *Combinatorial methods in computational algebraic geometry*
 Raúl E. Curto and David R. Larson, *Operator theory and triangular operator algebras*
 Michael R. Darnel, *Ordered algebraic structures*
 Robert S. Doran, *C*-algebras: 1943–1993 (a 50-year celebration)*
 Ed Dubinsky, *The state of research in undergraduate mathematics education: problems and prospects (AMS-MAA)*
 Krishan L. Duggal, *Differential geometry*
 Saber N. Elaydi, John R. Graef, and William F. Trench, *Stability and asymptotic behavior of difference equations*
 Dennis R. Estes and Donald James, *Quadratic forms*
 Naomi Fisher, Harvey B. Keynes, and Philip D. Wagreich, *Mathematics and education reform (AMS-MAA)*
 Robin Forman and John E. Luecke, *Topology and geometry*
 Dennis DeTurck and Carolyn S. Gordon, *Eigenvalues in Riemannian geometry*
 Morris W. Hirsch and Halbert White, *Dynamics and computation in neural networks*
 Hans A. Koch, Rafael de la Llave, and Charles Radin, *Dynamics of systems with infinitely many degrees of freedom*
 Xinzhi Liu and Seenith Sivasundaram, *Integro-differential equations: stability and control*
 David E. Marker and Philip H. Scowcroft, *Model theory and algebra*
 John E. McCarthy, *Holomorphic spaces*
 Alec Norton and Mary Lou Zeeman, *Low dimensional geometric dynamical systems*
 L. Alayne Parson and Mark Sheingorn, *Modular forms and related topics*
 Nikolay Reshetikhin, Leon Takhtajan, and Alexander Varchenko, *Quantum groups*

March 1993 Meeting in Knoxville, Tennessee

Southeastern Section

Associate Secretary:

Joseph A. Cima (until 1/31/93)

Robert J. Daverman (after 1/31/93)

Deadline for organizers: Expired

Deadline for consideration: December 15, 1992

David F. Anderson and David E. Dobbs, *Commutative ring theory*
 Bettye Anne Case, *Interventions to assure success: calculus through junior faculty*
 Ben G. Fitzpatrick and Suzanne M. Lenhart, *Optimal control and applications*
 Alexandre S. Freire, *Variational problems in geometry*
 Don B. Hinton and Kenneth Shaw, *Sturm-Liouville operators, applications, and extensions*

Tim Kelley, *Numerical methods in optimization*
 John C. Mayer, *Continua theory and dynamical systems*
 Balram S. Rajput and Jan Rosinski, *Stochastic processes*
 Michelle L. Wachs, *Algebraic combinatorics*

April 1993 Meeting in Salt Lake City, Utah

Western Section

Associate Secretary: Lance W. Small

Deadline for organizers: Expired

Deadline for consideration: January 6, 1993

April 1993 Meeting in Washington, DC

Eastern Section

Associate Secretary:

W. Wistar Comfort (until 1/31/93)

Lesley M. Sibner (after 1/31/93)

Deadline for organizers: Expired

Deadline for consideration: January 6, 1993

Roy L. Adler and Leopold Flatto, *Geodesic flows, hyperbolic geometry, and symbolic dynamics*
 Joseph A. Ball and Cora S. Sadosky, *Dilation and interpolation: operator theoretic methods*
 John J. Benedetto and Rodney B. Kerby, *Wavelets in sampling theory and signal processing*
 Joseph E. Bonin, *Geometric methods in combinatorics*
 Nathaniel Dean, *Graph theory*
 Edward Frenkel, *Mathematical physics*
 Anant P. Godbole and Gary J. Sherman, *Undergraduate research in applied mathematics*
 Anant P. Godbole and Gary J. Sherman, *Undergraduate research in pure mathematics*
 Valentina S. Harizanov and James C. Owings, *Pure and applied recursion theory*
 Kevin G. Hockett and E. Arthur Robinson, *Ergodic theory, dynamical systems, and applications*
 Yongwu Rong, *Low dimensional topology*
 Joel Spruck, *Nonlinear elliptic problems in geometry and physics*

May 1993 Meeting in DeKalb, Illinois

Central Section

Associate Secretary: Andy R. Magid

Deadline for organizers: Expired

Deadline for consideration: February 3, 1993

Michael A. Filaseta, *Number theory*
 Susan J. Friedlander, *Mathematical topics in fluid dynamics*
 Zoltan Furedi, *Combinatorics*
 Andrew J. Granville, *Analytic number theory*
 Frank Harary, *Beautiful graph theory*
 Mohsen Pourahmadi, *Stochastic processes*
 Linda R. Sons, *Function theory*
 Joel H. Spencer, *Probabilistic methods*
 Peter Weaterman, *Discrete groups*

August 1993 Meeting in Vancouver,

British Columbia, Canada

Associate Secretary: Lance W. Small

Deadline for organizers: November 11, 1992

Deadline for consideration: April 27, 1993

September 1993 Meeting in Syracuse, New York

Eastern Section
Associate Secretary: Lesley M. Sibner
Deadline for organizers: December 17, 1992
Deadline for consideration: April 27, 1993

October 1993 Meeting in Heidelberg, Germany

(Joint Meeting with the Deutsche Mathematiker-Vereinigung e.V.)
Associate Secretary: Robert M. Fossum
Deadline for organizers: December 23, 1992
Deadline for consideration: April 27, 1993

October 1993 Meeting in College Station, Texas

Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: January 22, 1993
Deadline for consideration: July 14, 1993

Randall K. Campbell-Wright, Carl C. Cowen, and Barbara D. MacCluer, *Composition operators on spaces of analytic functions*
David R. Larson, *Non self adjoint operator algebras*
Efton L. Park, *Noncommutative differential geometry*
Sung Yell Song and Paul M. Terwilliger, *Algebraic combinatorics*

January 1994 Meeting in Cincinnati, Ohio

Associate Secretary:
Joseph A. Cima (until 1/31/93)
Robert J. Daverman (after 1/31/93)
Deadline for organizers: April 5, 1993
Deadline for consideration: September 23, 1993

March 1994 Meeting in Lexington, Kentucky

Southeastern Section
Associate Secretary:
Joseph A. Cima (until 1/31/93)
Robert J. Daverman (after 1/31/93)
Deadline for organizers: June 18, 1993
Deadline for consideration: To be announced

March 1994 Meeting in Manhattan, Kansas

Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: June 25, 1993
Deadline for consideration: To be announced

June 1994 Meeting in Eugene, Oregon

Western Section
Associate Secretary: Lance W. Small
Deadline for organizers: September 7, 1993
Deadline for consideration: To be announced

October 1994 Meeting in Stillwater, OK

Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: January 28, 1994
Deadline for consideration: To be announced

January 1995 Meeting in Denver, Colorado

Associate Secretary: Andy R. Magid
Deadline for organizers: April 20, 1994
Deadline for consideration: To be announced

March 1995 Meeting in Chicago, Illinois

Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: June 24, 1994
Deadline for consideration: To be announced

January 1996 Meeting in Orlando, Florida

Associate Secretary: Lance W. Small
Deadline for organizers: April 12, 1995
Deadline for consideration: To be announced

March 1996 Meeting in Iowa City, Iowa

Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: June 22, 1995
Deadline for consideration: To be announced

Information for Organizers

Special Sessions at Annual and Summer Meetings are held under the supervision of the Program Committee for National Meetings (PCNM). They are administered by the Associate Secretary in charge of that meeting with staff assistance from the Meetings Department in the Society office in Providence.

According to the "Rules for Special Sessions" of the Society, Special Sessions are selected by the PCNM from a list of proposed Special Sessions in essentially the same manner as individuals are selected to give Invited Addresses. The number of Special Sessions at a Summer or Annual Meeting is limited. The algorithm that determines the number of Special Sessions allowed at a given meeting, while simple, is not repeated here, but can be found in "Rules for Special Sessions" on page 614 in the April 1988 issue of the *Notices*.

Each person selected to give an Invited Address is invited to generate a Special Session, either by personally organizing one or by having a Special Session organized by others. Proposals to organize a Special Session are sometimes requested either by the PCNM or by the Associate Secretary. Other proposals to organize a Special Session may be submitted to the Associate Secretary in charge of that meeting (who is an *ex-officio* member of the committee and whose address may be found below). These proposals must be in the hands of the PCNM at least nine months prior to the meeting at which the Special Session is to be held in order that the committee may consider all the proposals for Special Sessions simultaneously. Proposals that are sent to the Providence office of the Society, to the *Notices*, or directed to anyone other than the Associate Secretary will have to be forwarded and may not be received in time to be considered for acceptance.

It should be noted that Special Sessions must be announced in the *Notices* in such a timely fashion that any member of

the Society who so wishes may submit an abstract for consideration for presentation in the Special Session before the deadline for such consideration. This deadline is usually three weeks before the deadline for abstracts for the meeting in question.

Special Sessions are very effective at Sectional Meetings and can usually be accommodated. The processing of proposals for Special Sessions for Sectional Meetings is handled in essentially the same manner as for Annual and Summer Meetings by the Section Program Committee. Again, no Special Session at a Sectional Meeting may be approved so late that its announcement appears past the deadline after which members can no longer send abstracts for consideration for presentation in that Special Session.

The Society reserves the right of first refusal for the publication of proceedings of any Special Session. These proceedings appear in the book series *Contemporary Mathematics*.

More precise details concerning proposals for and organizing of Special Sessions may be found in the "Rules for Special Sessions" or may be obtained from any Associate Secretary.

Proposals for Special Sessions to the Associate Secretaries

The programs of Sectional Meetings are arranged by the Associate Secretary for the section in question:

Western Section

Lance W. Small, Associate Secretary
Department of Mathematics
University of California, San Diego
La Jolla, CA 92093
Electronic mail: g_small@math.ams.com
(Telephone 619-534-3590)

Central Section

Andy R. Magid, Associate Secretary
Department of Mathematics
University of Oklahoma
601 Elm PHSC 423
Norman, OK 73019
Electronic mail: g_magid@math.ams.com
(Telephone 405-325-6711)

Eastern Section

W. Wistar Comfort, Associate Secretary (until January 31, 1993)
Department of Mathematics
Wesleyan University
Middletown, CT 06457
Electronic mail: g_comfort@math.ams.com
(Telephone 203-347-9411)

Lesley M. Sibner, Associate Secretary (beginning February 1, 1993)
Department of Mathematics
Polytech University of New York
Brooklyn, NY 11201-2990
(Telephone 718-260-3505)

Southeastern Section

Joseph A. Cima, Associate Secretary (until January 31, 1993)
Department of Mathematics
University of North Carolina, Chapel Hill
Chapel Hill, NC 27599-3902
Electronic mail: g_cima@math.ams.com
(Telephone 919-962-1050)

Robert J. Daverman, Associate Secretary (beginning February 1, 1993)
Department of Mathematics
University of Tennessee
Knoxville, TN 37996-1300
(Telephone 615-974-6577)

As a general rule, members who anticipate organizing Special Sessions at AMS meetings are advised to seek approval at least nine months prior to the scheduled date of the meeting. No Special Sessions can be approved too late to provide adequate advance notice to members who wish to participate.

Proposals for Special Sessions at the October 1-3, 1993 meeting in Heidelberg, Germany, only, should be sent to Professor Fossum at the Department of Mathematics, University of Illinois, Urbana, IL 61801, Telephone: 217-244-1741, email:rmf@math.ams.com.

Information for Speakers

A great many of the papers presented in Special Sessions at meetings of the Society are invited papers, but any member of the Society who wishes to do so may submit an abstract for consideration for presentation in a Special Session, provided it is received in Providence prior to the special early deadline announced above and in the announcements of the meeting at which the Special Session has been scheduled. Contributors should know that there is a limitation in size of a single Special Session, so that it is sometimes true that all places are filled by invitation. Papers not accepted for a Special Session are considered as ten-minute contributed papers.

Abstracts of papers submitted for consideration for presentation at a Special Session must be received by the Providence office (Meetings Department, American Mathematical Society, P. O. Box 6887, Providence, RI 02940) by the special deadline for Special Sessions, which is usually three weeks earlier than the deadline for contributed papers for the same meeting. The Council has decreed that no paper, whether invited or contributed, may be listed in the program of a meeting of the Society unless an abstract of the paper has been received in Providence prior to the deadline.

Electronic submission of abstracts is available to those who use the $\text{\TeX}$ typesetting system. Requests to obtain the package of files may be sent electronically via the Internet to abs-request@math.ams.com. Requesting the files electronically likely will be the fastest and most convenient way, but users may also obtain the package on IBM or Macintosh diskettes, available free of charge by writing to: Electronic Abstracts, American Mathematical Society, Meetings Department, P.O. Box 6887, Providence, RI 02940, USA. When requesting the abstracts package, users should be sure to specify whether they want the plain $\text{\TeX}$, $\text{\AA\MS-TeX}$, or the $\text{\LaTeX}$ package.

Number of Papers Presented

Joint Authorship

Although an individual may present only one ten-minute contributed paper at a meeting, any combination of joint authorship may be accepted, provided no individual speaks more than once. An author can speak by invitation in more than one Special Session at the same meeting.

An individual may contribute only one abstract by title in any one issue of *Abstracts*, but joint authors are treated as a separate category. Thus, in addition to abstracts from two

individual authors, one joint abstract by them may also be accepted for an issue.

Site Selection for Sectional Meetings

Sectional Meeting sites are recommended by the Associate Secretary for the Section and approved by the Committee of Associate Secretaries and Secretary. Recommendations are usually made eighteen to twenty-four months in advance.

Host departments supply local information, ten to twelve rooms with overhead projectors for contributed paper sessions and Special Sessions, an auditorium with twin overhead projectors for invited addresses, and registration clerks. The Society partially reimburses for the rental of facilities and equipment, and for staffing the registration desk. Most host departments volunteer; to do so, or for more information, contact the Associate Secretary for the Section.

1992 Symposium on Some Mathematical Questions in Biology

Cell Biology

Denver, Colorado, November 1992

The twenty-sixth annual Symposium on Some Mathematical Questions in Biology, focusing on *Cell Biology*, will be held during the annual meeting of the American Society for Cell Biology, November 15–19, 1992, at the Colorado Convention Center in Denver, Colorado. The symposium is sponsored by the American Mathematical Society, the Society for Industrial and Applied Mathematics (SIAM), and the Society for Mathematical Biology (SMB).

The AMS-SIAM-SMB Committee on Mathematics in the Life Sciences serves as the Organizing Committee for the symposium. The committee members are Jack D. Cowan, James W. Curren, Marcus W. Feldman, Eric S. Lander, Marc Mangel (Chair), and James D. Murray. Byron Goldstein and Carla Wofsy serve as organizers.

There will be sessions on Monday and Tuesday afternoons, November 16 and 17, each including three invited lectures on mathematical and biophysical approaches to problems in cell biology. The speakers and their topics are: **Micah Dembo** (Los Alamos National Laboratory), *Modeling cell adhesion*; **Elliot**

Elson (Washington University School of Medicine, St. Louis), *Interpretation of measurements of cellular deformability*; **Byron Goldstein** (Los Alamos National Laboratory), *Cell activation through the aggregation of cell surface receptors*; **Jennifer Linderman** (University of Michigan, Ann Arbor), *Cell-cell interactions and the activation of T cells in an immune response*; **George Oster** (University of California, Berkeley), *The dynamics of single-motor molecules*; and **Michael Reed** (Duke University), *The transport of organelles in axons*.

Proceedings of the symposium will be published by the AMS in the series *Lectures on Mathematics in the Life Sciences*.

Discount airfares are available from United Airlines for travel November 12–22, 1992. Call 1-800-521-4041 and refer to file number 524YM.

For further information on the symposium, contact the Symposium Conference Coordinator, AMS, P.O. Box 6887, Providence, RI 02940, or DLS@MATH.AMS.COM by electronic mail.

Joint Mathematics Meetings in San Antonio

AMS Special Sessions and Contributed Papers

MAA Contributed Papers

The Joint Mathematics Meetings in San Antonio will be held January 13–16 (Wednesday–Saturday), 1993. (Please note that incorrect dates were published in this article in the May/June issue.) The first full announcement of the meetings will appear in the October 1992 issues of the *Notices* and *FOCUS*. This preliminary announcement is made to encourage member participation and to provide lead time for submission of abstracts for consideration for presentation in AMS Special Sessions and for submission of abstracts for AMS and MAA Contributed Paper Sessions.

AMS Special Sessions

A list of Special Sessions for this meeting can be found in the **Invited Addresses and Special Sessions** section of this issue.

Most of the papers to be presented at these Special Sessions will be by invitation; however, anyone contributing an abstract for the meeting who feels that his or her paper would be particularly appropriate for one of these sessions should indicate this clearly on the abstract, **and should submit it by September 18, 1992, three weeks earlier than the normal deadline for contributed papers**, in order that it be considered for inclusion.

Abstracts should be prepared on the standard AMS form available from the AMS office in Providence or in departments of mathematics and should be sent to Abstracts, Meetings Department, American Mathematical Society, Post Office Box 6887, Providence, RI 02940. A charge of \$16 is imposed for retyping abstracts that are not in camera-ready form.

AMS Contributed Paper Sessions

Abstracts should be prepared on the standard AMS form available from the AMS office in Providence or in departments of mathematics and should be sent to Abstracts, Meetings Department, American Mathematical Society, Post Office Box 6887, Providence, RI 02940, **so as to arrive by the abstract deadline of October 8, 1992**. A charge of \$16 is imposed for retyping abstracts that are not in camera-ready form. **Late papers will not be accepted.**

Electronic Submission of AMS Abstracts

This service is available to those who use the $\text{\TeX}$ typesetting system and can be used for abstracts of papers to be presented at this meeting in AMS sessions only. Requests to obtain the package of files may be sent by electronic mail on the Internet to abs-request@math.ams.com. Requesting the files electronically will likely be the fastest and most convenient way, but users may also obtain the package on IBM

or Macintosh diskettes, available free of charge by writing to: Director of Meetings, American Mathematical Society, P.O. Box 6887, Providence, RI 02940. When requesting the abstracts package, users should be sure to specify whether they want the plain $\text{\TeX}$, $\mathcal{A}\mathcal{M}\mathcal{S}\text{-}\text{\TeX}$, or the $\text{\LaTeX}$ package. Only abstracts should be sent to abs-submit@math.ams.com. Questions regarding an abstract should be addressed to abs-misc@math.ams.com. Questions regarding meetings should be addressed to meet@math.ams.com.

MAA Contributed Papers

Contributed papers are being accepted on several topics in collegiate mathematics for presentation in contributed paper sessions at the meeting. The organizers listed below solicit contributed papers pertinent to their sessions' interests and concerns; material should be sent to the organizer whose name is followed by an asterisk (*). A full description of each session appeared in the May/June and July/August *Notices*. Please note that any days scheduled for any session are tentative. The topics, organizers, and their affiliations are:

- *Assessment programs for the undergraduate major*, Friday morning and Saturday afternoon

Charles F. Peltier*
Department of Mathematics
Saint Mary's College
Notre Dame, IN 46556
email: cpeltier@bach.helios.nd.edu
fax: 219-284-4492

James W. Stepp, University of Houston

- *"Capstone" courses for senior mathematics majors*, Wednesday and Thursday mornings

Christopher E. Barat and Pamela Crawford*
Department of Mathematics
Randolph-Macon College
Ashland, VA 23005

- *Empowering the mathematical community*, Wednesday morning and Thursday afternoon

Gloria F. Gilmer*
Math-Tech, Inc.
9155 N. 70 St.
Milwaukee, WI 53223

Marilyn Frankenstein, University of Massachusetts, Boston
Patricia C. Kenschaft, Montclair State College
Alvin M. White, Harvey Mudd College

- *Impact of non-traditional instructional methods on testing and evaluation*, Wednesday and Thursday afternoons

Linda H. Boyd*

Mathematics Department
DeKalb College
555 North Indian Creek Dr.
Clarkston, GA 30021

Elizabeth Teles, Montgomery College, Maryland

- *Interactive learning environments*, Wednesday and Thursday mornings

Katherine Pedersen*

NSF Statewide Systemic Initiative
435 S. Chapelle
Pierre, SD 57501

Sandra Z. Keith, St. Cloud State University

- *Linear algebra*, Wednesday and Friday afternoons, and Thursday evening

Donald R. LaTorre*

Department of Mathematical Sciences
Clemson University
Clemson, SC 29634-1907

Steven J. Leon, University of Massachusetts, Dartmouth

A. Duane Porter (for the LACSG), University of Wyoming

- *Mathematics and the arts*, Thursday afternoon and Saturday morning

JoAnne S. Growney*

Department of Mathematics and Computer Science
Bloomsburg University
Bloomsburg, PA 17815

- *Recreational mathematical computing*, Friday morning and Saturday afternoon

Dr. Michael W. Ecker*

Editor/Publisher
Recreational & Educational Computing
909 Violet Terrace
Clarks Summit, PA 18411

- *Recruitment and retention of women in mathematics revisited*, Saturday morning and afternoon

Marcelle Bessman*

328 Braddock, #212
Frostberg, MD 21532
email: r2nkbbs@fre.towson.edu
fax: 813-872-9342
(May 10–Aug. 20, mailing address will be 644 Geneva Place,
Tampa, FL 33606)

- *Teaching mathematics to multicultural and multilingual students*, Friday morning and afternoon

Richard O'Lander*

Division of Computer Science, Mathematics & Science
St. John's University
St. Vincent's College
Grand Central & Utopia Parkways
Jamaica, NY 11439

- *Use of visualization in the teaching of mathematics*, Friday morning and Saturday afternoon

Howard Lewis Penn*

Mathematics Department
572 Holloway Rd.
United States Naval Academy
Annapolis, MD 21402-5002
email: hlp@math2.sma.usna.navy.mil

James R. King, University of Washington

- *Using data and computers in teaching statistics*, Wednesday morning and Thursday afternoon

Mary Parker*

Department of Mathematics
Austin Community College
11928 Stonehollow Drive
Austin, TX 78758-3101

George Cobb, Mount Holyoke College

Presentations are normally limited to ten minutes, although selected contributors may be given up to twenty minutes. Individuals wishing to submit a paper for any of these sessions should note the following **NEW PROCEDURES**: The name(s) and address(es) of the author(s) and a **one-page summary** of the paper should be sent **directly to the organizer whose address is given**. The purpose of this summary is to enable the organizer(s) to evaluate the appropriateness of the paper for the session, so this summary should be as detailed and informative as possible within the one-page limitation. This summary must reach the organizer by **September 10, 1992**. Summaries should **NOT** be sent to the MAA Washington office.

The organizer will acknowledge receipt of the summary. If the paper is accepted for presentation, the organizer will send the author(s) a standardized abstract form to be used to prepare a brief abstract, which will be published in the journal *Abstracts* (copies will be available in the registration area).

Completed abstract forms must be returned to the organizer promptly and **no later than September 24**. **Do not send the abstracts to the AMS, and do not submit them electronically**. Abstracts not received by that date cannot be published. If desired, an abstract form may be obtained in advance from either the AMS office in Providence or the MAA Washington office and the abstract may be submitted along with the summary.

Rooms where MAA contributed paper sessions will be held are equipped with an overhead projector and screen. Blackboards are **not** available. Persons having other equipment needs should contact the MAA Associate Secretary (Kenneth A. Ross, Department of Mathematics, University of Oregon, Eugene, OR 97403-1222; electronic mail: ross@math.uoregon.edu) as soon as possible, but in any case **prior to November 9**. Upon request, the following will be made available: one additional overhead projector/screen, 35mm carousel slide projector, or $1/2''$ or $3/4''$ VHS video cassette recorder with one color monitor.

Mathematical Sciences

Meetings and Conferences

1992

1992. **IMACS Symposium on Symbolic Computation in Engineering Design**, IDN, Lille, France. (Jul./Aug. 1990, p. 746)

1992. **IMACS International Conference on Computational Physics**, University of Colorado, Boulder, CO. (Oct. 1990, p. 1141)

September 1992

16–18. **Second SIAM Conference on Control in the 90s**, Minneapolis, MN. (Feb. 1991, p. 148)

16–20. **IMACS/SICE International Symposium on Robotics, Mechatronics and Manufacturing Systems**, Kobe, Japan. (Jan. 1992, p. 53)

17–19. **International Conference on Group Theory**, University of Timisoara, Romania. (Jul./Aug. 1991, p. 646)

17–19. **SIAM Conference on Control and its Applications**, Minneapolis, MN. (Mar. 1992, p. 248)

20–26. **Funktionalgleichungen**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

21–23. **Seventh International Conference on Multivariate Analysis in Memory of Ronald A. Fisher**, Barcelona, Spain. (Jan. 1992, p. 53)

21–23. **Workshop on Algebraic Cycles**, Mathematical Sciences Research Institute, Berkeley, CA. (Jan. 1992, p. 53)

21–23. **SIAM Workshop on Evolution of Phase Boundaries and Microstructure**, Leesburg, VA. (Jul./Aug. 1992, p. 627)

21–24. **Colloque de Probabilités**, Marseille, France. (Jul./Aug. 1992, p. 627)

21–25. **IMA Workshop on Robust Control Theory**, Institute for Mathematics and its Applications, University of Minnesota. (Sep. 1991, p. 839)

21–25. **Sixth Seminar "NUMDIFF" on Numerical Solution of Differential Equations and Applications**, Halle, Federal Republic of Germany. (Jul./Aug. 1992, p. 627)

* 21–25. **Introduction to Industrial Engineering**, Dallas, TX.

PROGRAM: This seminar is designed to strengthen job performance and to give a thorough indoctrination in industrial engineering basics. It focuses on the basics of methods engineering, work measurement, capital investment analysis, quality control, production/inventory control, material handling, and plant layout.

INFORMATION: Call IIE Customer Service Center at 404-449-0460.

22–26. **International Conference on Interval**

THIS SECTION contains announcements of meetings and conferences of interest to some segment of the mathematical public, including *ad hoc*, local, or regional meetings, and meetings or symposia devoted to specialized topics, as well as announcements of regularly scheduled meetings of national or international mathematical organizations. (Information on meetings of the Society, and on meetings sponsored by the Society, will be found inside the front cover.)

AN ANNOUNCEMENT will be published in the *Notices* if it contains a call for papers, and specifies the place, date, subject (when applicable), and the speakers; a second announcement will be published only if there are changes or necessary additional information. Once an announcement has appeared, the event will be briefly noted in each issue until it has been held and a reference will be given in parentheses to the month, year, and page of the issue in which the complete information appeared. Asterisks (*) mark those announcements containing new or revised information.

IN GENERAL, announcements of meetings and conferences held in North America carry only date, title of meeting, place of meeting, names of speakers (or sometimes a general statement on the program), deadlines for abstracts or contributed papers, and source of further information. Meetings held outside the North American area may carry more detailed information. In any case, if there is any application deadline with respect to participation in the meeting, this fact should be noted. All communications on meetings and conferences in the mathematical sciences should be sent to the Editor of the *Notices*, care of the American Mathematical Society in Providence.

DEADLINES for entries in this section are listed on the inside front cover of each issue. In order to allow participants to arrange their travel plans, organizers of meetings are urged to submit information for these listings early enough to allow them to appear in more than one issue of the *Notices* prior to the meeting in question. To achieve this, listings should be received in Providence SIX MONTHS prior to the scheduled date of the meeting.

EFFECTIVE with the 1990 volume of the *Notices*, the complete list of Mathematical Sciences Meetings and Conferences will be published only in the September issue. In all other issues, only meetings and conferences for the twelve-month period following the month of that issue will appear. As new information is received for meetings and conferences that will occur later than the twelve-month period, it will be announced at the end of the listing in the next possible issue. That information will not be repeated until the date of the meeting or conference falls within the twelve-month period.

and Stochastic Methods in Science and Engineering (INTERVAL '92), Moscow, Russia. (Jul./Aug. 1992, p. 627)

26–27. **Thirty-second Midwest Partial Differential Equations Seminar**, Purdue Univ., West Lafayette, IN. (May/Jun. 1992, p. 493)

27–October 3. **Darstellungstheorie Endlicher Gruppen**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

* 28–October 2. **Sixth Workshop on Computer Science Logic**, San Miniato, Italy. (Jul./Aug. 1992, p. 627)

* 28–October 2. **International Symposium on Operator Equations and Numerical Analysis**, Gosen near Berlin, Germany.

ORGANIZING COMMITTEE: S. Pröbldorf (Berlin), B. Silbermann (Chemnitz).

CONFERENCE TOPICS: Approximation methods for integral and pseudodifferential equations; Numerical analysis for boundary integral equations on nonsmooth surfaces; Banach algebra techniques in operator theory; Applications of integral and pseudodifferential equations.

INFORMATION: S. Pröbldorf/M. Teuchert (Conference Manager), Institute for Applied Analysis and Stochastics (IAAS), Hausvogteiplatz 5–7, D-O-1086 Berlin, Germany, Tel: + 030 20377 555/+ 030 20377 594; FAX: +030 2004975.

29–October 2. **Theorie Analytique des Nombres**, Marseille, France. (Jul./Aug. 1992, p. 627)

30–October 2. **Thirtieth Annual Allerton Conference on Communication, Control, and Computing**, University of Illinois, IL. (Feb. 1992, p. 147)

31–October 4. **Third International Conference on Function Spaces**, Institute of Mathematics, Adam Mickiewicz University, Poznan, Poland. (Feb. 1992, p. 147)

October 1992

October 1992. **Workshop on Superprocesses and Interacting Systems**, Centre de Recherches Mathématiques, Université de Montréal, Montréal, Quebec, Canada. (Apr. 1992, p. 348)

2–3. **Fourth Midwest Conference on the History of Mathematics**, Miami University, Oxford, OH. (Mar. 1992, p. 249)

4–10. **Funktionalanalysis**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

5–9. **Option: Journées Thematiques Médicis**, Marseille, France. (Jul./Aug. 1992, p. 627)

9–10. **Developments from the Stone Age**, University of Chicago, Chicago, IL. (May/Jun. 1992, p. 493)

*9–12. **Workshop on Vector Bundles on Algebraic Varieties**, University of California, Los Angeles.

INVITED SPEAKERS: A. Beauville, F. Bogomolov, R. Friedman, D. Gieseker, S. Mukai, S. Ramanan, A. Szenes.

INFORMATION: R. Lazarsfeld, Dept. of Math., UCLA, Los Angeles, CA 90024; email: rkl@math.ucla.edu.

11–17. **Arbeitsgemeinschaft mit Aktuellem Thema**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

12–14. **Mathematical Topics in Biology**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 627)

12–16. **IMA Workshop on Control Systems Design for Advanced Engineering Systems: Complexity, Uncertainty, Information, and Organization**, Institute for Mathematics and its Applications, University of Minnesota. (Sep. 1991, p. 840)

12–16. **Workshop on Visualization of Geometric Structures**, Mathematical Sciences Research Institute, Berkeley, CA. (Jan. 1992, p. 54)

12–16. **International Conference on Polynomial Automorphisms and Related Topics**, CIRM, Luminy, France. (Jan. 1992, p. 54)

14–20. **First African Conference on Research in Computer Science**, Yaounde, Cameroon. (Feb. 1992, p. 147)

15–16. **Fuzzy Logic: Entwicklungsmethoden und Werkzeuge**, Bonn, Federal Republic of Germany. (Jul./Aug. 1992, p. 627)

15–17. **Jumelage 92**, Mathematical Sciences Institute, Ithaca, NY. (Apr. 1992, p. 348)

15–17. **Interface and Layer Dynamics**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 627)

15–19. **SIAM Conference on Applications of Dynamical Systems**, Salt Lake City, UT. (Mar. 1992, p. 249)

*16–17. **Fourteenth Midwest Probability Colloquium**, Northwestern University, Evanston, IL.

INVITED SPEAKERS: H. Kesten (two lectures on first- and last-passage percolation); T. McConnell and S. Evans (one lecture).

INFORMATION: M. Pinsky, Dept. of Math., Northwestern U., Evanston, IL 60208; email: m.pinsky@math.nwu.edu.

*16–17. **1992 Mathematical Sciences Department Chairs Colloquium**, Arlington, VA. (See the News and Announcements section of the 1992 July/August *Notices*, p. 601, for further details.)

CONFERENCE THEME: Chairing the changing mathematical sciences department of the 1990s.

KEYNOTE SPEAKER: D. Allan Bromley, Assistant to the President for Science and Technology.

INFORMATION: Board on Mathematical Sciences, National Research Council, NAS 312, 2101 Constitution Ave., NW, Washington, DC 20418; 202-334-2421; FAX: 202-334-1597; email: bms@nas.edu or bms@nas.bitnet.

17. **Three Decades of Numerical Linear Algebra at Berkeley: A Conference in Honor of the Sixtieth Birthdays of Beresford Parlett and William Kahan**, University of California, Berkeley. (Mar. 1992, p. 249)

18–24. **Geometrie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

19–21. **The Fourth Symposium on the Frontiers of Massively Parallel Computation**, McLean, VA. (Dec. 1991, p. 1340)

19–23. **Modeles Arch et Applications a la Finance**, Marseille, France. (Jan. 1992, p. 54)

19–23. **Fourth International Symposium on Orthogonal Polynomials and their Applications**, Evian, France. (Feb. 1992, p. 148)

20–23. **Second Beijing International Conference on System Simulation and Scientific Computing-BICSC '92**, Beijing, China. (Jan. 1992, p. 54)

21–23. **Documents, Computation, and Preference**, Washington, DC. (Apr. 1992, p. 349)

21–25. **Workshop on Conservative Systems and Quantum Chaos**, Fields Institute for Research in Mathematical Sciences, Waterloo, Ontario. (Jul./Aug. 1992, p. 627)

*22–23. **Conference on Modular Forms and Number Theory to Celebrate the 80th Birth-**

day of Joe Lehner, Swarthmore College, Swarthmore, PA.

INVITED SPEAKERS: G. Andrews, A.O.L. Atkins, B. Berndt, D. Bressoud, L. Ehrenpreis, H. Iwaniec, M. Knopp, M. Newman, L.A. Parson, D. Rosen, M. Sheingorn, Sister A. Heath.

INFORMATION: D. Rosen (215-543-2752, drosen1@cc.swarthmore.edu.) and M. Knopp (215-664-3534 or 215-787-7589), 410 Lancaster Ave., Apt. 221, Haverford, PA 19041.

22–24. **General and Geometric Topology and Related Problems**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 628)

22–24. **Mathematical Analysis of Phenomena in Fluid and Plasma Dynamics**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 628)

22–25. **Semi-Annual Regional Workshop in Dynamical Systems and Related Topics**, Penn State University, State College, PA. (May/Jun. 1992, p. 493)

22–30. **Forty-sixth Conference and Congress of the International Federation for Information and Documentation**, Madrid, Spain. (May/Jun. 1991, p. 477)

25–31. **Stochastische Analysis**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

26–30. **Holomorphic Mappings and Diophantine Geometry**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 628)

*27–29. **NSF/DoD's National SBIR Conferences**, Washington, DC.

PROGRAM: The NSF/DoD-sponsored National Small Innovation Research (SBIR) Conferences provide a unique marketing opportunity by bringing together scores of personnel from Federal agency and major corporations in one place at one time. Representatives from the Depts. of Defense, Health & Human Services (including NIH), Energy, Education, Transportation, Commerce, and NASA, National Science Foundation, Environmental Protection Agency, and Nuclear Regulatory Commission will discuss R&D opportunities at their agencies in seminars and one-on-one meetings. Also participating are companies such as Boeing, General Dynamics, Martin Marietta, Motorola, TRW, Honeywell, IBM, Hughes, Texas Instruments, United Technologies, and Teledyne.

INFORMATION: Contact the Conference Coordinator at 407-274-4005.

27–31. **International Workshop on Modern Group Analysis: Advanced Analytic and Computational Methods in Mathematical Physics**, Acireale (Catania), Italy.

(May/Jun. 1992, p. 493)

* 28–November 1. **Symposium on Trends in Discrete Mathematics**, Bielefeld, Germany.

PURPOSE: The purpose of this symposium is to give an overview on current and future trends in discrete mathematics.

ORGANIZING COMMITTEE: W. Deuber (Bielefeld), H.-J. Prömel (Bonn), B. Voigt (Frankfurt).

INVITED SPEAKERS: M. Aigner, Berlin; B. Bollobas, Cambridge; P. Erdős, Budapest, R.L. Graham, Murray Hill; P. Gritzmann, Trier; M. Grötschel, Berlin; J.H. Spencer, NY; C. Thomassen, Copenhagen; W.T. Trotter, Morristown; I. Wegener, Dortmund.

INFORMATION: W. Thumser, Fakultät für Mathematik, Universitätsstr. D-4800 Bielefeld; thumser@math10.mathematik.uni-bielefeld.de; or T. Valentin, ZiF, Wellenberg 1, D-4800 Bielefeld; FAX: (0) 521/106-2782.

30–31. **Seventh Annual Pi Mu Epsilon Regional Undergraduate Mathematics Conference**, St. Norbert College, DePere, WI. (Jul./Aug. 1992, p. 628)

30–November 1. **Central Section**, Wright State University, Dayton, OH.

INFORMATION: W. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

31. **Differential Geometry Day**, Eastern Illinois University, Charleston, IL. (May/Jun. 1992, p. 493)

November 1992

November 1992. **The International Lie-Lobachevsky Colloquium Dedicated to the Anniversaries of Sophus Lie's 150 birthday and Nikolai Lobachevski's 200 birthday**, Tartu (Estonia). (Feb. 1992, p. 148)

November 1992. **Workshop on Stochastic Control**, Centre de Recherches Mathématiques, Université de Montréal, Montréal Quebec, Canada. (Apr. 1992, p. 349)

1–6. **The First Pan American Conference on Pre-Columbia Mathematics, Astronomy, and Modes of Thought**, Univ. Francisco Marroquín, Guatemala City and Tikal. (Dec. 1991, p. 1340)

1–7. **Kombinatorik**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

2–4. **Colloque Mathématique-Informatique**, Marseille, France. (Jul./Aug. 1992, p. 628)

2–6. **Workshop on Symbolic Dynamics**, Mathematical Sciences Research Institute, Berkeley, CA. (Jan. 1992, p. 54)

2–20. **Fourth Autumn Course on Mathematical Ecology**, Trieste, Italy. (Jul./Aug. 1992, p. 628)

4–6. **Mathematical Methods for Wave Phenomena in Fluids and Their Application**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 628)

4–6. **Fundamental Technologies in Numerical Computation**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 628)

4–6. **Structure of Solutions of Partial Differential Equations**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 628)

5–8. **Eighteenth Annual Conference of the American Mathematical Association of Two Year Colleges**, Indianapolis, IN. (Jul./Aug. 1992, p. 628)

7–11. **Mathematics and Molecular Biology III: Computational Approaches to Nucleic Acid Structure and Function**, Santa Fe, NM. (May/Jun. 1992, p. 494)

8–14. **Numerische Integration**, Oberwolfach, Federal Republic of Germany. (February 1991, p. 148)

8–14. **Third Austrian Symposium on the History of Mathematics**, Neuhofen an der Ybbs (Lower Austria). (Mar. 1992, p. 249)

9–11. **Fundamental Problems in Quantum Field Theory**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 628)

9–13. **IMA Workshop on Control and Optimal Design of Distributed Parameter Systems**, Institute for Mathematics and its Applications, University of Minnesota. (Nov. 1991, p. 1171)

* 9–13. **Introduction to Industrial Engineering**, Seattle, WA.

PROGRAM: This seminar is designed to strengthen job performance and to give a thorough indoctrination in industrial engineering basics. It focuses on the basics of methods engineering, work measurement, capital investment analysis, quality control, production/inventory control, material handling, and plant layout.

INFORMATION: Call IIE Customer Service Center at 404-449-0460.

10–13. **Interdisciplinary Studies on Number Theory**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 628)

13–15. **Second Joint Meeting of the Midwest Conference on Ordinary Differential Equations and the Southeastern-Atlantic Regional Conference on Differential Equations**, University of Kentucky, Lexington, KY. (Apr. 1992, p. 349)

14–16. **The Third Biennial Conference of the Allahabad Mathematical Society**, Allahabad, India. (May/Jun. 1991, p. 477)

15–20. **An Applications Symposium on Optics, Electro-Optics, and Lasers in Industry**,

Boston, MA. (Feb. 1992, p. 148)

15–21. **Komplexitätstheorie**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

16–18. **Workshop on Higher Dimensional Geometry**, Mathematical Sciences Research Institute, Berkeley, CA. (Jan. 1992, p. 54)

16–18. **Hardy Spaces and Uniform Algebras**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)

16–20. **International Congress on Numerical Methods in Engineering and Applied Sciences**, University of Concepción, Concepción, Chile. (Jul./Aug. 1991, p. 646)

16–20. **IMA Period of Concentration: Flow Control**, Institute for Mathematics and its Applications, University of Minnesota. (Sep. 1991, p. 840)

* 16–20. **The Fifth Annual High Performance Computing and Communication Conference—Supercomputing 92**, Minneapolis, MN. (Please note updated program information from May/Jun. 1992, p. 494)

PROGRAM: The program will include 18 tutorials, 8 invited lecturers, and 80 technical paper presentations. There will be exhibitions sponsored by over 50 companies plus Research Exhibits, a Visualization Theater, and Poster Exhibits. The education program at Supercomputing '92 will introduce secondary school teachers to high-performance computing and will host over 100 high school students visiting Supercomputing '92. Also, current developments in supercomputing technology utilizing the scientific network, SCinet '92, a high-speed communications network linking exhibitors and remote locations will be featured. SCinet offers an opportunity to see and experience hands-on demonstrations of the technical feasibility for building a networked supercomputing environment using HIPPI, FDDI, Ethernet, local fiber, T3, and other technologies. In addition, a *heterogeneous computing challenge* will be hosted.

16–20. **Automorphic Forms and L-functions**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)

16–22. **Workshop on Normal Forms, Homoclinic Bifurcations and Chaos**, Fields Institute for Research in Mathematical Sciences, Waterloo, Ontario. (Apr. 1992, p. 350)

* 17–19. **NSF/DoD's National SBIR Conferences**, Phoenix, AZ.

PROGRAM: The NSF/DoD-sponsored National Small Innovation Research (SBIR) Conferences provide a unique marketing opportunity by bringing together scores of personnel from Federal agency and major corporations in one place at one time. Representatives from the Depts. of Defense, Health & Human Services (including NIH), Energy, Education, Transportation, Com-

merce, and NASA, National Science Foundation, Environmental Protection Agency, and Nuclear Regulatory Commission will discuss R&D opportunities at their agencies in seminars and one-on-one meetings. Also participating are companies such as Boeing, General Dynamics, Martin Marietta, Motorola, TRW, Honeywell, IBM, Hughes, Texas Instruments, United Technologies, and Teledyne.

INFORMATION: Contact the Conference Coordinator at 407-274-4005.

18–20. **Mathematical Optimization and its Applications**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)

20–22. **Academic Knowledge and Power**, University of Maryland, College Park, MD. (May/Jun. 1992, p. 494)

* 22–26. **Geometry of Hamiltonian Systems**, Conference Center "Woudschoten", The Netherlands.

PROGRAM: This school is meant for Ph.D. students who are willing to prepare themselves thoroughly in order to reach research level in this subject. The school consists of three courses of eight lectures each, exercising hours and discussions.

SPEAKERS AND TOPICS: V. Guillemin symplectic aspects of multiplicity theory; A. Kirillov - geometric quantization and the orbit method; P. Van Moerbeke - integrable Hamiltonian systems.

INFORMATION: Autumn School "Geometry of Hamiltonian Systems", Attn: Jean Arthur, Math. Instituut RUU, P.O. Box 80010, 3508 TA Utrecht, The Netherlands; email: arthur@math.ruu.nl.

23–25. **European Symposium on Research in Computer Security**, Toulouse, France. (Feb. 1992, p. 148)

23–27. **Séminaire Sud-Rhodanien de Géométrie**, Marseille, France. (Jan. 1992, p. 54)

24–26. **Spectral and Scattering Theory for Differential Equations**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)

24–26. **Theory and Applications in Computer Algebra**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)

29–December 5. **Theory of Large Deviations**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

* 30–December 2. **Algorithm, Fractal, and Dynamical Systems**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)

December 1992

2–4. **Workshop on Curves, Abelian Vari-**

eties, and their Moduli, Mathematical Sciences Research Institute, Berkeley, CA. (Jan. 1992, p. 54)

4–5. **International Workshop on Matrix Methods for Statistics**, University of Auckland, Auckland, New Zealand. (Feb. 1992, p. 148)

6–12. **Theory and Numerical Methods for Initial-Boundary Value Problems**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

7–11. **IMACS Symposium on Scientific Computing and Mathematical Modelling**, Bangalore, India. (May/Jun. 1991, p. 477)

7–11. **Algebraic Number Theory—Recent Developments and Their Backgrounds**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)

8–11. **International Conference on Computer Science and Control**, Paris, France. (Apr. 1992, p. 350)

11–16. **Workshop on Generalized Inverses—Computational Techniques and Applications**, Indian Statistical Institute, Delhi, India. (Mar. 1992, p. 249)

13–19. **Asymptotische Statistik**, Oberwolfach, Federal Republic of Germany. (Feb. 1991, p. 148)

15–17. **Third IMA Conference on Mathematics Signal Processing**, University of Warwick, England. (Feb. 1992, p. 149)

17–19. **Algebraic Combinatorics**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)

27–31. **Holiday Symposium on Lie Group Representations and Combinatorics**, New Mexico State University, Las Cruces, NM. (Sep. 1991, p. 840)

1993

1992–1993. **Mittag-Leffler Institute's Academic Program for 1992–1993: Special Problems in Mathematical Physics**, Djursholm, Sweden. (Nov. 1991, p. 1171)

Spring 1993. **IMACS Symposium on Mathematical Modelling**, Wiener Neustadt, Germany. (Jan. 1992, p. 54)

1993. **Second IMACS International Conference on Computational Physics**, Univ. of Colorado, Boulder, CO. (Jan. 1992, p. 55)

January 1993

1–3. **International Symposium on Statistical Physics**, Salt Lake City, Calcutta, India. (Jul./Aug. 1992, p. 629)

3–7. **International Conference on Scientific Computation and Differential Equations**, Auckland, New Zealand. (May/Jun. 1991, p. 477)

3–9. **Grundlagen der Geometrie**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

3–9. **Extensions of Buildings and Geometries**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

4–9. **Advances in Computational Mathematics**, India International Center, New Delhi, India. (Feb. 1992, p. 149)

* 5. **Short Course on Nonlinear Dynamics and Chaos**, Arizona State University, Tempe, AZ.

SHORT COURSE TOPICS: Introduction and basic concepts; strange attractors; bifurcations to chaos; fractal basin boundaries; attractor reconstruction (time series analysis); controlling chaos.

INVITED SPEAKERS: J.A. Yorke and C. Grebogi of the University of Maryland.

INFORMATION: E. Kostelich, Dept. of Math., Arizona State Univ., Tempe, AZ 85287-1804; 602-965-5006; FAX: 602-965-8119; email: eric@saddle.la.asu.edu.

* 6–9. **Dynamics Days Arizona, Twelfth Annual International Workshop**, Arizona State University, Tempe, AZ.

ORGANIZERS: E. Kostelich, Arizona State U.; R. Behringer, Duke U.

CONFERENCE TOPICS: Mathematical, numerical, and experimental aspects of nonlinear dynamics and chaos; pattern formation; turbulence; applications to the physical, chemical and biological sciences; and related topics.

INFORMATION: E. Kostelich, Dept. of Math., Arizona State Univ., Tempe, AZ 85287-1804; 602-965-5006; FAX: 602-965-8119; email: eric@saddle.la.asu.edu.

* 7–11. **Conference on Evolution Equations**, Louisiana State University, Baton Rouge, LA.

CONFERENCE TOPICS: Linear and nonlinear partial differential equations, semigroups of operators, equations of evolution, control theory, calculus of variations, and related topics.

INFORMATION: J. Robert Dorroh, G. Freyre, G. Goldstein, J. Goldstein, F. Neubrander, or P. Wolenski at the Dept. of Math., Louisiana State Univ., Baton Rouge, LA 70803.

10–15. **First Panamerican Workshop in Applied and Computational Mathematics**, Simon Bolivar University, Caracas, Venezuela. (May/Jun. 1992, p. 494)

10–16. **Computational Methods for Nonlinear Phenomena**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

12–14. **Topology and Field Theory of 3-4 Dimensional Algebras**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 629)

13-16. **Joint Mathematics Meetings**, San Antonio, TX. (including the annual meetings of the AMS, AWM, MAA, and NAM)

INFORMATION: H. Daly, AMS, P.O. Box 6887, Providence, RI 02940.

15-16. **1992-1993 ASL Winter Meeting**, San Antonio, TX. (May/Jun. 1992, p. 495)

* 15-17. **International Conference on Complex Analysis and its Applications**, Hong Kong Univ. of Science and Technology, Hong Kong. (Please note the updated Information section from Jul./Aug. 1992, p. 630)

INFORMATION: Chung-Chun Yang or Yue-Kuen Kwok, Mathematics Dept., Hong Kong Univ. of Science and Technology, Clear Water Bay Rd., Hong Kong; email: maykwok@usthk.bitnet; FAX: 852-358-1643.

17-22. **1993 IEEE International Symposium on Information Theory**, San Antonio, TX. (Feb. 1992, p. 149)

17-23. **Combinatorial Optimization**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

18-21. **Numerical Analysis of Partial Differential Equations in Engineering and Related Topics**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 630)

20-22. **Hyperfunctions and Differential Equations**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 630)

24-30. **Optimale Steuerung Partieller Differentialgleichungen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

25-27. **Fourth ACM-SIAM Symposium on Discrete Algorithms (SODA)**, Austin, Texas.

25-29. **IMA Workshop on Robotics**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1171)

26-28. **The Development of Algebraic Topology**, Research Institute for Mathematical Sciences, Kyoto University. (Jul./Aug. 1992, p. 630)

31-February 6. **Asymptotics and Adaptivity in Computational Mechanics**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

February 1993

1-3. **IMA Minisymposium on Biological Control of Movement**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

* 5-7. **Representation Theory and Analysis on Homogeneous Spaces in Memory of**

Lawrence Corwin, Rutgers University, New Brunswick, NJ.

PROGRAM: The main objective of the conference is to present recent developments in representation theory and analysis on homogeneous spaces, with an emphasis on nilpotent Lie groups and reductive p-adic groups, two fields to which L. Corwin made important contributions. The program of invited one-hour talks will include both surveys and more specialized lectures, directed toward mathematicians working in a broad range of areas related to Lie group representations.

ORGANIZING COMMITTEE: S. Gindikin (Rutgers), R. Goodman (Rutgers), F. Greenleaf (Courant), R. Howe (Yale), J. Lepowsky (Rutgers), L. Rothschild (UC San Diego), P. Sally (Chicago), N. Wallach (UC San Diego), J. Wolf (UC Berkeley).

INFORMATION: R. Goodman, S. Gindikin, or J. Lepowsky, Dept. of Math., Rutgers Univ., New Brunswick, NJ 08903; Fax: 908-932-5530; goodman@math.rutgers.edu.

* 7-11. **The 29th Australian Applied Mathematics Conference (AMC '93)**, Hahndorf, South Australia.

PROGRAM: The conference provides an interactive forum for presentation of results and discussions on applied problems derived in many scientific fields and amenable to quantitative description and solution.

SPEAKERS AND TOPICS: J. Filar (U. of South Australia) - greenhouse modelling, control/system theoretic approach to greenhouse effect; R. May (Oxford U.) - mathematical biology, spatial chaos and its role in ecology and evolution; B. Moran (Flinders U.) - neural networks and image processing; C.J. van Duijn (Delft U.) - nonlinear diffusion, convection/diffusion, groundwater hydraulics; B. Haverkort (U. of Twente) - performance analysis of communication networks and computer systems; K.R. Sreenivasan (Yale U.) - self-similarity, self-affinity and turbulence dynamics.

INFORMATION: Conference Secretary, 29AMC, Dept. of Applied Math., The Univ. of Adelaide, GPO Box 498, Adelaide, South Australia 5001.

7-13. **Partielle Differentialgleichungen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

8-17. **IMA Workshop on Nonsmooth Analysis and Geometric Methods in Deterministic Optimal Control**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Mar. 1992, p. 250)

14-20. **Applicable Algebra**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

* 15-19. **1993 Mathematics-in-Industry Study Group**, Melbourne, Australia.

PROGRAM: The goals of the study group are: To stimulate greater awareness in Australian industry of the need for and role of mathematics; to establish better links between industry and academic mathematicians; to provide improved university education of mathematicians through 1). expanded employment prospects for mathematics graduates, 2). fresh research problems for mathematicians, and 3). innovative material for teaching courses; and to provide Australian industry with high level mathematical advice on challenging problems, and to provide an opportunity for industrial scientists to receive expert training in mathematical modelling.

INFORMATION: N.G. Barton, CSIRO Division of Math. and Stats., P.O. Box 218, Lindfield, NSW 2070; tel: (02) 413 7702; FAX: (02) 416 9317; email: noel@syd.dms.csiro.au.

21-27. **Curves, Images, Massive Computation**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

22-28. **Workshop on Pattern Formation and Symmetry Breaking**, Fields Institute for Research in Mathematical Sciences, Waterloo, Ontario. (Apr. 1992, p. 351)

25-March 1. **A Conference on Numerical Analysis with Automatic Result Verification**, Lafayette, LA. (May/Jun. 1992, p. 495)

28-March 6. **Medical Statistics: Statistical Methods for Risk Assessment**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

March 1993

7-13. **Mathematische Stochastik**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

14-20. **Gewöhnliche Differentialgleichungen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

* 15-18. **Arithmetic Geometry with an Emphasis on Iwasawa Theory**, Arizona State University, Tempe, AZ.

ORGANIZERS: N. Childress, J. Jones.

INVITED SPEAKERS: *Tentative*: N. Elkies (Harvard), B. Gross (Harvard), T. Metsankyla (Finland), B. Perrin-Riou (France), K. Ribet (California), K. Rubin (Ohio State), G. Stevens (Boston U.).

TALKS: Participants wishing to give a talk should send an abstract to the address below. Please indicate the desired length for the talk (30 or 50 minutes). The deadline for submission of abstracts is January 15, 1993. Submissions by email (in $\text{\TeX}$) are welcome.

FUNDING: Graduate students and recent Ph.D.s are encouraged to apply for funding by sending a C.V. to the address below. The deadline is December 15, 1992.

INFORMATION: Arithmetic Geometry Meeting, Dept. of Math., Arizona State Univ., Tempe, AZ 85287; email: meeting@artin.la.asu.edu.

15–19. **IMA Workshop on Systems and Control Theory for Power Systems**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

17–20. **Pure and Applied Linear Algebra: The New Generation**, University of West Florida, Pensacola, FL. (May/Jun. 1992, p. 495)

21–24. **Sixth SIAM Conference on Parallel Processing for Scientific Computing**, Norfolk, VA. (Mar. 1992, p. 250)

21–27. **Analysis auf Lokalsymmetrischen Räumen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 55)

22–28. **Workshop on Pattern Formation in Earth Sciences and Biology**, Fields Institute for Research in Mathematical Sciences, Waterloo, Ontario. (Apr. 1992, p. 351)

28–April 3. **Combinatorial Convexity and Algebraic Geometry**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

29–April 2. **Workshop on Diophantine Geometry**, Mathematical Sciences Research Institute, Berkeley, CA. (May/Jun. 1992, p. 495)

April 1993

* 4–7. **First International Conference on Mathematical Linguistics**, Barcelona, Spain.

CHAIRMAN: C. Martin-Vide.

INFORMATION: C. Martin-Vide, Univ. de Barcelona, Facultat de Filologia, Seccio de Linguistica, Gran Via de les Corts, Catalanes, 585, E-08007 Barcelona.

4–10. **Topics in Pseudo-Differential Operators**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

5–9. **IMA Tutorial: Design and Analysis of Adaptive Systems**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

* 8–10. **Clifford Algebras in Analysis**, University of Arkansas, Fayetteville, AR.

PRINCIPAL SPEAKER: A. McIntosh, Macquarie University, Australia.

INVITED SPEAKERS: H.B. Lawson, R. Coifman, J. Gilbert, B. Jawerth, C. Kenig, M. Michelsohn, M. Mitrea, M. Murray, J. Pipher, S. Semmes, G. Verchota, Z.J. Wu. CALL FOR PAPERS: Contributed papers should be submitted before February 15, 1993.

INFORMATION: J. Ryan or I. Monroe,

Dept. of Math. Sci., SCEN 301, Univ. of Arkansas, Fayetteville, AR 72701.

9–10. **Western Section**, University of Utah, Salt Lake City, Utah.

INFORMATION: W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

11–17. **Arbeitsgemeinschaft mit Aktuellem Thema**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

12–16. **IMA Workshop on Adaptive Control, Filtering, and Signal Processing**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

* 12–16. **GAMM-Jahrestagung 1993**, Dresden, Germany.

INFORMATION: M. Ludwig, Abteilung Mathematik, Technische Universität Dresden, Mommsenstrabe 13, D-O-8027 Dresden, Germany.

14–16. **Seventh SEFI European Seminar on Mathematics in Engineering Education**, Eindhoven University of Technology, The Netherlands. (Feb. 1992, p. 149)

* 14–16. **The Mathematics of Food Production, Processing, and Presentation**, Belfast, Great Britain.

INFORMATION: The Conference Officer, The Institute of Math and its Applications, 16 Nelson St., Southend-on-Sea, Essex, SS1 1EF, UK.

15–22. **Symposium on Analytic and Geometric Aspects of Hyperbolic Geometry: Research Level Workshop**, University of Warwick, Coventry, UK. (Mar. 1992, p. 250)

18–24. **The Arithmetik of Fields**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

18–24. **Mathematische Grundlagen und Numerische Verfahren bei Transsonischen Strömungen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

19–21. **SIAM Conference on Mathematical and Computational Issues in the Geosciences**, Houston, TX. (Jul./Aug. 1992, p. 631)

25–May 1. **Low Dimensional Dynamics**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

* 27–29. **NSF/DoD's National SBIR Conferences**, Minneapolis, MN.

PROGRAM: The NSF/DoD-sponsored National Small Innovation Research (SBIR) Conferences provide a unique marketing opportunity by bringing together scores of personnel from Federal agency and major corporations in one place at one time. Representatives from the Depts. of Defense, Health & Human Services (including NIH), Energy, Education, Transportation, Com-

merce, and NASA, National Science Foundation, Environmental Protection Agency, and Nuclear Regulatory Commission will discuss R&D opportunities at their agencies in seminars and one-on-one meetings. Also participating are companies such as Boeing, General Dynamics, Martin Marietta, Motorola, TRW, Honeywell, IBM, Hughes, Texas Instruments, United Technologies, and Teledyne.

INFORMATION: Contact the Conference Coordinator at 407-274-4005.

May 1993

3–7. **IMA Tutorial: Verification Issues in Discrete Event Systems, as well as Performance and Control**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

3–9. **Workshop on Ecological Systems**, Fields Institute for Research in Mathematical Sciences, Waterloo, Ontario. (Apr. 1992, p. 352)

9–15. **Reelle Algebraische Geometrie**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

9–17. **Jerusalem Combinatorics '93**, Hebrew University of Jerusalem, Israel. (Jul./Aug. 1992, p. 631)

10–12. **IMACS Symposium on Signal Processing and Neural Networks-SPANN '93**, Université du Québec at Montréal, Canada. (Jan. 1992, p. 56)

10–14. **IMA Workshop on Discrete Event Systems, Manufacturing Systems, and Communication Networks**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

16–22. **Mathematical Problems in Viscoelastic Flows**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

20–23. **International Conference on Approximation Probability and Related Fields**, University of California, Santa Barbara, CA. (May/Jun. 1991, p. 477)

21–22. **Central Section**, Northern Illinois University, DeKalb, IL.

INFORMATION: W.S. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

23–29. **Differentialgeometrie im Grossen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

24–27. **COMPEURO '93**, Paris-Evry, France. (Jul./Aug. 1992, p. 631)

* 30–June 1. **Canadian Society for the History and Philosophy of Mathematics**, Carleton University, Ottawa, Ontario, Canada. (Please note additions to Jul./Aug. 1992, p. 631)

SPECIAL SESSION: There will be a special session on the philosophy of mathemat-

ics organized by R.S.D. Thomas, Applied Math. Dept., University of Manitoba, Winnipeg, Manitoba, R3T 2N2, Canada.

30-June 5. **Funktionalanalysis und Nicht-lineare Partielle Differentialgleichungen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

June 1993

June 1993. **Fourth IMACS International Symposium on Computational Acoustics**, Cambridge, England. (Jan. 1992, p. 56)

* June 1993. **GAMM/IFIP - Workshop on Stochastic Optimization: Numerical Methods and Technical Applications**, Neubiberg/München, Germany.

PROGRAM COMMITTEE: H.A. Eschenauer (Siegen), P. Kall (Zürich), K. Marti (Neubiberg), F. Pfeiffer (München), G.I. Schuëler (Innsbruck).

INFORMATION: K. Marti, Institut für Mathematik und Rechneranwendung, Fakultät für Luft- und Raumfahrttechnik, Universität der Bundeswehr München, Werner-Heisenberg-Weg 39, D-8014 Neubiberg/München, Tel: (089) 6004-2541/2109; FAX: (089) 6004-3560.

* 2-5. **Ninth Biennial Conference of the Association of Christians in the Mathematical Sciences**, Westmont College, Santa Barbara, CA.

INVITED SPEAKERS: J. Dauben, CUNY; D. Knuth, Stanford U.

CALL FOR PAPERS: Abstract deadline: December 1, 1992.

INFORMATION: R. Howell, Westmont College, Santa Barbara, CA 93108; 805-565-6178; email: howell@westmont.edu.

6-9. **Annual Meeting of the Statistical Society of Canada**, Wolfville, Nova Scotia, Canada. (Feb. 1992, p. 149)

6-12. **Analysis auf Kompakten Varietäten**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

7-10. **SIAM Conference on Mathematical and Numerical Aspects of Wave Propagation Phenomena**, University of Delaware, Newark, DE. (Jul./Aug. 1992, p. 631)

7-11. **IMA Tutorial: Mathematical Theory which Has become an Integral Part of Modern Financial Economics**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

7-13. **Workshop on Pattern Formation and Cellular Automata**, Fields Institute for Research in Mathematical Sciences, Waterloo, Ontario. (Apr. 1992, p. 352)

13-19. **Differential-Algebraic Equations: Theory and Applications in Technical Sim-**

ulation, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

14-17. **The Fifth Asian Logic Conference**, National University of Singapore, Singapore. (May/Jun. 1992, p. 496)

14-18. **IMA Workshop on Mathematical Finance**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Nov. 1991, p. 1172)

14-18. **Linear Logic Workshop**, Mathematical Sciences Institute, Cornell University, Ithaca, NY. (May/Jun. 1992, p. 496)

15-18. **Third IMACS International Workshop on Qualitative Reasoning and Decision Technologies-QR&DT-3**, Polytechnique of Barcelona, Spain. (Jan. 1992, p. 56)

20-26. **Konvexgeometrie**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 56)

* 21-25. **Twenty-second Conference on Stochastic Processes and their Applications**, Amsterdam, The Netherlands.

INFORMATION: SPA '93, c/o CWI, P.O. Box 4079, NL-1009 AB Amsterdam.

* 21-25. **Graphs on Surfaces**, Johns Hopkins University, Baltimore, MD.

PROGRAM: The 16th Mathematical Sciences Lecture Series will feature ten lectures by C. Thomassen on the subject "Graphs on surfaces". A few additional invited talks will supplement Thomassen's lectures.

INFORMATION: Organizer, E.R. Scheinerman, Dept. of Math. Sciences, The Johns Hopkins Univ., Baltimore, MD 21218-2689; voice: 410-516-7210; FAX: 410-516-7459; Internet: ers@cs.jhu.edu or Bitnet: ers@jhuunix.

23-26. **Convergence in Ergodic Theory and Probability**, Ohio State University, Columbus, OH. (May/Jun. 1992, p. 496)

27-July 3. **Algebraische K-Theorie**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

* 29-July 2. **Number Theoretic and Algebraic Methods in Computer Science**, International Center of Scientific and Technical Information (ICSTI), Moscow.

PROGRAM: There will be invited and contributed talks, a poster session, and a problem session.

CONFERENCE COMMITTEE: H. Zimmer (Chair), G. Cohen, S. Cohen, J. von zur Gathen, D. Grigorev, M. Kaminski, G. Mullen, H. Niederreiter, A. Odlyzko, M. Pohst, C. Pomerance, A. Poorten, C. Schnorr, I. Shparlinski, S. Vladuts.

CONFERENCE TOPICS: Factoring and primality testing; computational algebraic number theory; number-theoretical methods in computing; irreducible, primitive, permutation and other special polynomials; recurring sequences and finite automata;

algebraic methods in complexity theory; algebraic coding theory; and cryptography. CALL FOR TOPICS: A three page summary of proposed talk should be submitted by November 15, 1992.

INFORMATION: I. Shparlinski, Dept. no. 4, ICSTI, Kuusinenstr., 21 B, Moscow, 12552, Russia; FAX: (095) 943 00 89; email: shpar@plb.icsti.su or G.L. Mullen, Math. Dept., Pennsylvania State Univ., University Park, PA 16802; email: mullen@math.psu.edu.

July 1993

4-9. **Fifth International Fuzzy Systems Association World Congress**, Seoul, Korea. (Mar. 1992, p. 250)

4-10. **Freie Randwertprobleme**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

* 4-10. **Fifth International Congress on Algebraic Hyperstructures and Applications**, Iasi, Romania.

SCIENTIFIC COMMITTEE: P. Corsini (Italy), J. Jantosciak ((U.S.A.)), J. Mittas (Greece), Y. Sureau (France), T. Vougiouklis (Greece). CONFERENCE TOPICS: Semihypergroups, hypergroups, hyperrings, hyperspaces; Ordered hyperstructures; Related topics as join spaces, cogroups, polygroups, and other multivalued structures.

INVITED SPEAKERS: P. Corsini (Italy), J. Mittas (Greece).

CALL FOR PAPERS: Abstracts should be typewritten, ready for reproduction, and should not exceed one page. The deadline is May 1, 1993.

INFORMATION: M. Stefanescu, I. Tofan, and M. Gutsan, Faculty of Math., A.I.Cuza University, 6600 - Iasi - Romania.

6-9. **European Multigrid Conference '93**, Amsterdam, The Netherlands. (May/Jun. 1992, p. 496)

* 7-10. **The Second International Conference on Fluid Mechanics (ICFM-II)**, Beijing, China.

CONFERENCE TOPICS: Flow instability and turbulence; aerodynamics and gas dynamics; geophysical and astrophysical fluid mechanics; hydrodynamics; plasma dynamics and magneto-hydrodynamics; biofluid mechanics; physico-chemical fluid dynamics; nonNewtonian fluid and multiphase flows; industrial and environmental fluid mechanics; and others.

INFORMATION: Z. Zhaoshun, Dept. of Engineering Mechanics, Tsinghua University, 100084, Beijing, China.

11-17. **Nonlinear Evolution Equations, Solutions and the Inverse Scattering Transform**, Oberwolfach, Federal Republic of Ger-

- many. (Jan. 1992, p. 57)
- 12-16. **SIAM Annual Meeting**, Philadelphia, PA. (Mar. 1992, p. 251)
- 12-23. **Conference on Universal Algebra and Category Theory**, Mathematical Sciences Research Institute, Berkeley, CA. (May/Jun. 1992, p. 496)
- 18-24. **Dynamische Systeme**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)
- 21-25. **Twenty-Second Conference on Stochastic Processes and Their Applications**, Amsterdam, The Netherlands. (Jan. 1992, p. 57)
- 25-31. **Geometric Methods in Theoretical and Computational Mechanics**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

August 1993

- 1-7. **Abelsche Gruppen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)
- 1-14. **Groups 93 Galway/St. Andrews**, Galway, Ireland. (May/Jun. 1992, p. 496)
- 2-6. **Second Gauss Symposium**, Munich, Germany. (May/Jun. 1992, p. 497)
- * 2-6. **International Symposium on the Mathematical Theory of Networks and Systems**, Regensburg, Germany.

PURPOSE: The symposium offers theoretically oriented engineers and mathematicians in systems, control, and circuit theory a platform to discuss recent developments, to exchange new ideas, and to analyze trends for future research.

CONFERENCE TOPICS: Mathematics for control, multivariable and robust control, systems modeling, systems identification, stochastic and adaptive control, optimal control, filtering, robotics, signal processing and circuit theory, VLSI, neural networks and control theoretic aspects of artificial intelligence.

CALL FOR PAPERS: Deadline for submission of papers and proposals of special sessions: November 1, 1992. Please submit three copies of an unpublished paper in English. The length of the paper should not exceed 10 pages.

INFORMATION: MTNS 93, U. Helmke, Department of Math., University of Regensburg, D-8400 Regensburg, Germany; FAX: +49-941-943-4005/2305; email: helmke@vax1.rz.uni-regensburg.dbp.de.

- 2-13. **Georgia International Topology Conference**, University of Georgia, Athens, GA. (May/Jun. 1992, p. 497)
- 4-6. **SIAM Conference on Simulation and Computational Probability**, San Francisco, CA. (Jul./Aug. 1992, p. 632)

- * 7-21. **Semigroups and their Applications**, York, England.

INFORMATION: J. Fountain, Dept. of Math., Univ. of York, Heslington, York YO1 5DD, UK.

- 8-14. **Konstruktive Approximationstheorie**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)
- 9-12. **Joint Statistical Meetings**, San Francisco, CA. (Nov. 1991, p. 1172)
- * 9-13. **Sixth International Conference on Structural Safety and Reliability (ICOSSAR '93)**, Innsbruck, Austria.

CHAIRMEN: G.I. Schueller, Innsbruck; M. Shinozuka, Princeton.

INFORMATION: ICOSSAR '93 Secretariat, c/o Institute of Engineering Mechanics, Univ. of Innsbruck, Technikerstraße 13, A-6020 Innsbruck.

- 13-17. **Second International Colloquium on Numerical Analysis**, Plovdiv, Bulgaria. (Dec. 1991, p. 1341)
- 15-21. **Noncommutative Algebra and Representation Theory**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)
- 16-19. **Third SIAM Conference on Linear Algebra in Signals, Systems, and Control**, University of Washington, Seattle, WA. (Jul./Aug. 1992, p. 632)
- * 16-20. **First European Nonlinear Oscillations Conference**, Hamburg, Germany.

INVITED SPEAKERS: P.S. Landa (Moscow State U.), J.E. Marsden (U. of California, Berkeley), P.D. Panagiotopoulos (Aristotle U.), W.O. Schiehlen (U. of Stuttgart), J.M.T. Thompson (University College London), H. True (Technical University of Denmark), Y. Ueda (Kyoto U.), F. Verhulst (U. of Utrecht).

CONFERENCE TOPICS: Qualitative analysis of nonlinear dynamic systems; quantitative methods for nonlinear systems; bifurcation theory; numerical methods in nonlinear dynamics; nonlinear random vibrations; phenomena and criteria of chaotic oscillations; computer aided symbolic methods in dynamics; vibration control; experimental methods in vibration theory; and applications in mechanical engineering, electrical engineering, physics, biology, chemistry, and other sciences.

CALL FOR PAPERS: Prospective authors are invited to submit three copies of a 300-400 word summary (one single page only) indicating one of the topics from above to which it should be assigned. Summaries must be received by February 1, 1993.

INFORMATION: Ing. E. Kreuzer, Arbeitsbereich Meerestechnik II, Technische Universität Hamburg-Harburg, Eißendorfer Str. 42, D-2100 Hamburg 90, Tel: (040) 7718-

3120; FAX: (040) 7718-2684.

- 17-20. **The Mathematical Heritage of Sir William Rowan Hamilton**, Dublin, Ireland. (May/Jun. 1992, p. 497)

- * 17-20. **International Symposium on Statistics with Non-precise Data**, Innsbruck, Austria.

INFORMATION: R. Viertl, Institut für Statistik und Wahrscheinlichkeitstheorie, Technische Univ. Wien, A-1040 Wien.

- * 17-21. **Second International Conference on Finite Fields: Theory, Applications, and Algorithms**, University of Nevada, Las Vegas.

PROGRAM: The conference will feature several invited one-hour lectures and several invited half-hour lectures. There will also be sessions for 15 minute contributed papers. A refereed conference proceedings is planned.

INVITED SPEAKERS: *Tentative*: S. Cohen, J. Dillon, R. Evans, M. Fried, M. Fushimi, J. von zur Gathen, D. Hayes, N. Koblitz, H. Lenstra, R. Lidl, G. Mullen, H. Niederreiter, A. Odlyzko, V. Pless, V. Shoup, I. Shparlinski, S. Vanstone, J. Yu.

INFORMATION: P. Shiu or D. Wan, Dept. of Math. Sci., Univ. of Nevada, Las Vegas, NV 89154; 702-739-3748; FAX: 702-597-4343; email: shiu@nevada.edu, dwan@nevada.edu, or G. Mullen, Math. Dept., Pennsylvania State Univ., University Park, PA 16802; 814-865-9413; mullen@math.psu.edu.

- 18-22. **Fourth International Colloquium on Differential Equations**, Plovdiv, Bulgaria. (Dec. 1991, p. 1341)

- 22-28. **Special Complex Varieties**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

- 22-29. **Twenty-ninth International Congress of History of Science**, Zaragoza, Spain. (Apr. 1992, p. 352)

- 23-28. **International Conference on Algebra Dedicated to the Memory of M.I. Kargapolov**, Krasnoyarsk, Russia. (Jul./Aug. 1992, p. 632)

- 25-September 3. **Forty-ninth Biennial Session of the International Statistical Institute**, Firenze, Italy. (Nov. 1991, p. 1172)

- 29-September 4. **Random Graphs and Combinatorial Structures**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

- * 30-September 3. **Inverse Problems: Principles and Applications in Geophysics, Technology, and Medicine**, Potsdam (near Berlin), Germany.

INFORMATION: G. Anger, Rathausstr. 13, Wg. 11/09, D-O-1020 Berlin; email: anger@de.dbp.uni-halle.mathematik.

September 1993

5–11. **Novikov Conjectures, Index Theorems and Rigidity**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

5–12. **First World Conference on Branching Processes**, Varna, Bulgaria. (May/Jun. 1992, p. 497)

12–18. **Topologie**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

13–17. **Fourth European Software Engineering Conference**, Garmisch, Germany. (Jul./Aug. 1992, p. 632)

13–18. **Different Aspects of Differentiability**, Warsaw, Poland. (May/Jun. 1992, p. 497)

19–25. **Mathematical Game Theory**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

22–23. **Central Section**, Texas A&M University, College Station, TX.

INFORMATION: W.S. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

26–October 2. **Diophantische Approximationen**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

The following new announcements will not be repeated until the criteria in the last paragraph in the box at the beginning of this section are met.

October 1993

3–9. **Arbeitsgemeinschaft mit Aktuellem Thema**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

17–23. **Geometrie**, Oberwolfach, Federal Republic of Germany. (Jan. 1992, p. 57)

25–29. **Third SIAM Conference on Geometric Design**, Seattle, WA. (Jul./Aug. 1992, p. 632)

31–November 6. **Algorithmische Methoden der Diskreten Mathematik**, Oberwolfach, Federal Republic of Germany. (Mar. 1992, p. 251)

November 1993

21–27. **Mathematische Modelle in der Biologie**, Oberwolfach, Federal Republic of Germany. (Mar. 1992, p. 251)

28–December 4. **Nonlinear Equations in Many-Particle Systems**, Oberwolfach, Federal Republic of Germany. (Mar. 1992, p. 251)

January 1994

5–8. **Joint Mathematics Meetings**, Cincinnati, OH. (including the annual meetings of the AMS, AWM, MAA, and NAM)

INFORMATION: H. Daly, AMS, P.O. Box 6248, Providence, RI 02940.

February 1994

* 2–4. **IMACS Symposium on Mathematical Modelling**, Vienna, Austria.

INFORMATION: I. Troch, Inst. für Analysis, Technische Mathematik und Versicherungsmathematik, TU Wien, Wiedner Hauptstr. 8 - 10, A-1040 Wien, Tel: 0222/588 01.

March 1994

25–26. **Central Section**, Kansas State University, Manhattan, KS.

INFORMATION: W.S. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

May 1994

* 24–27. **Conference on Hermann G. Graßmann (1809–1877)**, Isle of Rügen, Germany.

PROGRAM: The 150th anniversary of the publication of Graßmann's major mathe-

matical work, the "lineale Ausdehnungslehre" (1844), will be the occasion to present a comprehensive picture of this great scholar's life and work. Particular emphasis will be given to his influence, which has scarcely been studied in detail as yet—in mathematics as well as in physics and in linguistics.

INFORMATION: G. Schubring, Institut für Didaktik der Mathematik, Universität Bielefeld, Postfach 100131, D-W 4800 Bielefeld 1.

June 1994

13–17. **Fifth International Conference on Hyperbolic Problems Theory, Numerical Methods, and Applications**, Stony Brook, NY. (May/Jun. 1992, p. 497)

August 1994

1–5. **Third World Congress on Computational Mechanics (WCCM III)**, Chiba, Japan. (May/Jun. 1992, p. 497)

3–11. **The International Congress of Mathematicians 1994**, Zürich, Switzerland. (Mar. 1992, p. 249)

1995

Second International Conference on Numerical Methods for Volterra and Delay Equations (A conference to celebrate the 100th anniversary of Volterra's birth.), Italy. (Mar. 1992, p. 251)

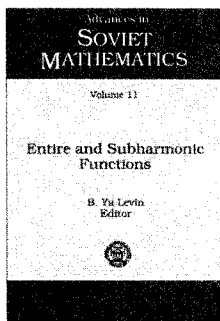
March 1995

24–25. **Central Section**, DePaul University, Chicago, IL. (Please note date was previously incorrectly listed as 1993.)

INFORMATION: W.S. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

New Publications Offered by the AMS

ADVANCES IN SOVIET MATHEMATICS



Entire and Subharmonic Functions

B. Ya. Levin, Editor
Volume 11

The papers in this collection, written by participants of the Research Seminar on the Theory of Functions at Kharkov University, primarily address the theory of entire and subharmonic functions. Founded in 1953 by B. Ya. Levin and still functioning today, this seminar ranges

over different problems in the theory of functions, functional analysis, and related problems in calculus and mathematical physics. *Entire and Subharmonic Functions* contains works presented recently in the seminar.

Contents

A. M. Ulanovskii, *On the completely regular growth of analytic functions having maximum on a Ray*; **M. Sodin**, *Value distribution of sequences of rational functions*; **M. Simbirskii**, *Inverse problem for the Sturm-Liouville operator with almost-periodic potential having only positive Fourier exponents*; **L. I. Ronkin**, *Subharmonic functions of completely regular growth in a closed cone*; **L. R. Podoshnev**, *Complete description of the pair indicator-lower indicator of an entire function*; **I. V. Ostrovskii**, *Solvability conditions for the homogeneous Riemann boundary problem with an infinite index*; **Yu. I. Lyubarskii and V. A. Tkachenko**, *Completeness of a system of functions on sets in the complex plane*; **Yu. I. Lyubarskii**, *Frames in the Bargmann space of entire functions*; **B. Ya. Levin, V. N. Logvinenko, and M. L. Sodin**, *Subharmonic functions of finite degree bounded on subsets of the "Real Hyperplane"*; **A. A. Goldberg and V. A. Pyana**, *Uniqueness theorems for algebraic functions*; **A. E. Fryntov**, *Subharmonic functions and $\cos(\pi\lambda)$ -theorems for entire functions represented by gap series*; **V. N. Logvinenko and S. Yu. Favorov**, *Lacunary series and Fourier integrals of functions of several variables*; **A. E. Eremenko and M. L. Sodin**, *Parametrization of entire functions of sine-type by their critical values*; **L. B. Golinskii and G. P. Chistyakov**, *On stability estimates in the Marcinkiewicz theorem and its generalization*; **V. S. Azarin and V. B. Giner**, *Limit sets and multipliers of entire functions*.

1991 *Mathematics Subject Classification*: 14H05, 30B05, 30C80, 30D15, 30D20, 30D35, 30E05, 30E25, 31A02, 31A05, 34A55, 34B24, 42B10, 60E10; 31A05, 34L10, 34L15, 42A75

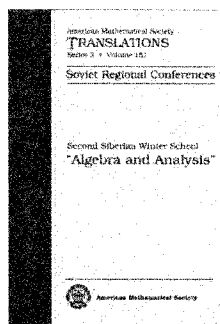
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L. A. Bokut', and Yu. G.
Reshetnyak, Editors
Volume 151

This book, the second in the series of proceedings of Soviet Regional

Conferences, contains papers presented at the Second Siberian Winter School: Algebra and Analysis, held at Tomsk State University in 1989. The papers touch on a variety of topics, including Lie algebras and Lie groups, sheaves, superalgebras, graded Lie algebras, Teichmüller theory, nonstandard functional analysis, hyperbolic geometry, p -adic L -functions, automorphic forms, and resolution of singularities.

Contents

A. V. Alekseevskii, *On gradings of simple Lie algebras connected with groups generated by transvections*; **A. B. Verevkin**, *On a noncommutative analogue of the category of coherent sheaves on a projective scheme*; **I. L. Kantor**, *Jordan and Lie superalgebras determined by a Poisson algebra*; **S. L. Krushkal**, *New methods and trends in geometric function theory*; **A. G. Kusraev and S. S. Kutateladze**, *Nonstandard methods in geometric functional analysis*; **A. D. Mednykh**, *Automorphism groups of three-dimensional hyperbolic manifolds*; **A. A. Panchishkin**, *Automorphic forms, L -functions, and p -adic analysis*; **S. I. Trifonov**, *Resolution of singularities in one-parameter analytic families of differential equations*.

1991 *Mathematics Subject Classification*: 11SXX, 14F05, 17-XX, 32-XX, 46S20, 11FXX, 30-XX, 58-XX

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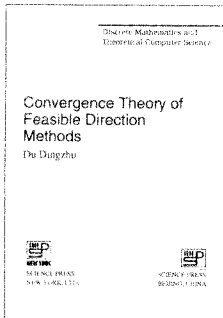
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APPLIED DISCRETE MATHEMATICS AND THEORETICAL COMPUTER SCIENCE



Convergence Theory of Feasible Direction Methods Du Dingzhu Volume 1

This monograph, the first in a new series published by Science Press New York and Science Press Beijing and distributed by the AMS, covers various aspects of convergence theory for feasible

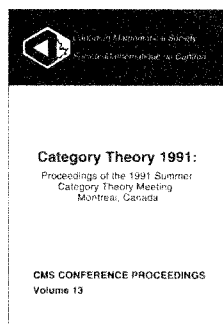
direction methods in nonlinear programming. In particular, slope lemmas play an important role here, providing a means for simplifying the theory. Following the historical development, Dingzhu uses gradient projection methods as threads throughout the book. Many basic results included here have not appeared in other books on this subject. Providing a state-of-the-art review of activity in convergence theory, this small book will prove useful as an introduction to the field as well as a reference for specialists.

Contents

Introduction and preliminaries; Slope lemmas; Rosen's method and its convergence; Combining with variable metric methods; ϵ -Active set strategy; Reduced gradient methods; Point-to-set mapping; On other topics.

1991 *Mathematics Subject Classification*: 90, 49
ISBN 1-880132-00-1; 7-03-002633-0/O.495 Science Press, Beijing
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CONFERENCE PROCEEDINGS, CANADIAN MATHEMATICAL SOCIETY



Category Theory 1991: Proceedings of the 1991 Summer Category Theory Meeting, Montreal, Canada R.A.G. Seely, Editor Volume 13

As category theory approaches its first half-century, it continues to grow, finding new applications in areas that

would have seemed inconceivable a generation ago, as well as in more traditional areas. The language, ideas, and techniques of category theory are well suited to discovering unifying structures in apparently different contexts. Representing this diversity of the field, this book contains the proceedings of an international conference on category theory. The

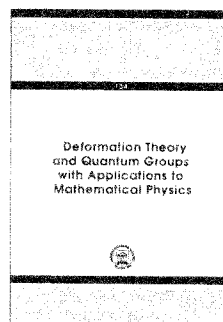
subjects covered here range from topology and geometry to logic and theoretical computer science, from homotopy to braids and conformal field theory. Although generally aimed at experts in the various fields represented, the book will also provide an excellent opportunity for nonexperts to get a feel for the diversity of current applications of category theory.

Contents

A. Bagchi, *DeMorgan's law and related identities in classifying topoi*; **B. Banaschewski and A. Pultr**, *A Stone duality for metric spaces*; **R. Betti**, *Sheaves in cocomplete categories*; **D. Bourn**, *Low dimensional geometry of the notion of choice*; **M. Bunge**, *Classifying toposes and fundamental localic groupoids*; **A. Carboni, M. C. Pedicchio, and N. Pirovano**, *Internal graphs and internal groupoids in Mal'cev categories*; **G. Castellini, J. Koslowski, and G. E. Strecker**, *Hereditary and modal closure operators*; **H. A. Chen and P. H. Chu**, *What is a Gabriel topology over a graded ring?*; **J. R. B. Cockett and D. Spencer**, *Strong categorical datatypes I*; **Y. Diers**, *The Zariski category of graded commutative rings*; **R. C. Flagg**, *Completeness in continuity spaces*; **K. A. Hardie and K. H. Kamps**, *Variations on a theme of Dold*; **H. Hu**, *Dualities for accessible categories*; **J. Isbell**, *Some problems in descriptive locale theory*; **J. F. Jardine**, *Modelling homotopy coherence*; **G. Jarzembki**, *Elementary reflections of concrete categories of mixed structures*; **M. Johnson and S.-H. Sun**, *Remarks on representations of universal algebras by sheaves of quotient algebras*; **V. Lyubashenko**, *Categorical aspects of conformal field theory*; **S. Mac Lane**, *Coherence theorems and conformal field theory*; **S. Majid**, *Braided groups and duals of monoidal categories*; **C. J. Mulvey and J. W. Pelletier**, *A quantisation of the calculus of relations*; **D. Pavlović**, *A logical view on the adjoint functor theorem*; **G. Richter**, *Axiomatizing algebraically behaved categories of Hausdorff spaces*; **R. Rosebrugh and R. J. Wood**, *Relational databases and indexed categories*; **K. I. Rosenthal**, *Linear indexed quantales and quantalic hyperdoctrines*; **M. Sobral and W. Tholen**, *Effective descent morphisms and effective equivalence relations*; **V. Trnková**, *Functorial selection of morphisms*.

1991 *Mathematics Subject Classification*: 18-06; 00B10, 18-02
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CONTEMPORARY MATHEMATICS



Deformation Theory and Quantum Groups with Applications to Mathematical Physics Murray Gerstenhaber and James D. Stasheff, Editors Volume 134

Quantum groups are not groups at all, but special kinds of Hopf algebras of which the most important are closely

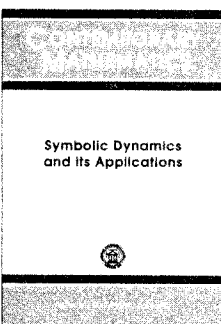
related to Lie groups and play a central role in the statistical and wave mechanics of Baxter and Yang. Those occurring physically can be studied as essentially algebraic and closely related to the deformation theory of algebras (commutative, Lie, Hopf, and so on). One of the oldest forms of algebraic quantization amounts to the study of deformations of a commutative algebra A (of classical observables) to a noncommutative algebra A_h (of operators) with the infinitesimal deformation given by a Poisson bracket on the original algebra A .

This volume grew out of an AMS-IMS-SIAM Joint Summer Research Conference, held in June 1990 at the University of Massachusetts at Amherst. The conference brought together leading researchers in the several areas mentioned and in areas such as "q special functions", which have their origins in the last century but whose relevance to modern physics has only recently been understood. Among the advances taking place during the conference was Majid's reconstruction theorem for Drinfel'd's quasi-Hopf algebras. Readers will appreciate this snapshot of some of the latest developments in the mathematics of quantum groups and deformation theory.

Contents

M. Cohen, *Hopf algebra actions—revisited*; **P. Cotta-Ramusino and M. Rinaldi**, *Link diagrams, Yang Baxter equations, and quantum holonomy*; **L. Crane**, *Duality and topology of 3-manifolds*; **M. Gerstenhaber and S. D. Schack**, *Algebras, bialgebras, quantum groups, and algebraic deformations*; **J. M. Gracia-Bondía**, *Generalized Moyal quantization on homogeneous symplectic spaces*; **R. Grossman and D. Radford**, *A simple construction of bialgebra deformations*; **G. F. Helminck**, *Integrable deformations of meromorphic equations on $\mathbb{P}^1(\mathbb{C})$* ; **N. H. Jing**, *Quantum groups with two parameters*; **H. T. Koelink**, *Quantum group theoretic proof of the addition formula for continuous q-Legendre polynomials*; **H. T. Koelink and T. H. Koornwinder**, *q-special functions, a tutorial*; **T. H. Koornwinder**, *q-special functions and their occurrence in quantum groups*; **V. Lakshmibai and N. Reshetikhin**, *Quantum flag and Schubert schemes*; **L. A. Lambe**, *Homological perturbation theory, Hochschild homology, and formal groups*; **S. Majid**, *Tannaka-Krein theorem for quasi-Hopf algebras and other results*; **S. Montgomery**, *Simple smash products*; **J. H. Przytycki**, *Quantum group of links in a handlebody*; **A. Jeu-Liang Sheu**, *Quantum Poisson $SU(2)$ and quantum Poisson spheres*; **S. Shnider**, *Deformation cohomology for bialgebras and quasi-bialgebras*; **J. Stasheff**, *Drinfel'd's quasi-Hopf algebras and beyond*; **M. Takeuchi**, *Hopf algebra techniques applied to the quantum group $U_q(\mathfrak{sl}(2))$* ; **D. N. Yetter**, *Framed tangles and a theorem of Deligne on braided deformations of Tannakian categories*; **C. Zachos**, *Elementary paradigms of quantum algebras*.

1991 *Mathematics Subject Classification*: 16W30, 17B37, 18D10, 81R05
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Symbolic Dynamics and its Applications

Peter Walters, Editor
Volume 135

This volume contains the proceedings of the conference, Symbolic Dynamics and its Applications, held at Yale University in the summer of 1991 in honor of Roy L. Adler on his sixtieth birthday. The conference focused on symbolic dynamics and its applications

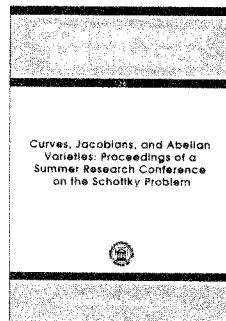
to other fields, including ergodic theory, smooth dynamical systems, information theory, automata theory, and statistical mechanics. One hundred thirty-nine participants attended from thirteen countries, representing mathematics, applied mathematics, electrical engineering, and physics departments in universities and in industry. Featuring a range of contributions from some of the leaders in the field, this volume presents an excellent overview of the subject.

Contents

R. L. Adler, *The torus and the disk*; **B. Weiss**, *On the work of Roy Adler in ergodic theory and dynamical systems*; **B. Marcus**, *The impact of Roy Adler's work on symbolic dynamics and applications to data storage*; **J. Ashley**, *L. R.*

conjugacies of shifts of finite type are uniquely so; **C. Bernhardt and E. M. Coven**, *A polynomial time algorithm for deciding the forcing relation on cyclic permutations*; **F. Blanchard**, *Fully positive topological entropy and topological mixing*; **M. Boyle**, *The stochastic shift equivalence conjecture is false*; **A. Broglio and P. Liardet**, *Predictions with automata*; **D. Fiebig**, *Common closing extensions and finitary regular isomorphism for synchronized systems*; **D. Fiebig and U.-R. Fiebig**, *Covers for coded systems*; **L. Flatto**, *Z-numbers and β -transformations*; **M. V. Jakobson**, *Quasisymmetric conjugacies for some one dimensional maps inducing expansion*; **J.-M. Gambaudo and C. Tresser**, *A monicity property of one dimensional dynamics*; **D. Handelman**, *Finiteness of conjugacy classes of restricted block upper triangular matrices*; **D. Handelman**, *Polynomials with some power being positive*; **D. Handelman**, *Spectral radii of primitive integral companion matrices and log concave polynomials*; **R. Kenyon**, *Self-replicating tilings*; **B. P. Kitchens and K. Schmidt**, *Markov subgroups of $(\mathbb{Z}/2\mathbb{Z})^{\mathbb{Z}^2}$* ; **F. Ledrappier**, *On the dimension of some graphs*; **D. Perrin and M. P. Schutzenberger**, *Synchronizing prefix codes and automata and the road coloring problem*; **S. Mozes**, *A zero entropy mixing of all orders tiling system*; **W. Parry**, *A cocycle equation for shifts*; **W. Parry**, *In general a degree 2 map is an automorphism*; **C. Radin**, *$\mathbb{Z}^n$ versus $\mathbb{Z}$ for systems of finite type*; **F. Rhodes**, *Principal vectors of commuting block maps*; **I. A. Salama**, *On the recurrence of countable topological Markov chains*; **B. Solomyak**, *Substitutions, adic transformations and beta-expansions*; **M. Smorodinsky**, *Finitary isomorphism of m-dependent processes*; **P. Trow**, *Constant to one factor maps and dimension groups*; **S. Tuncel**, *Faces of Markov chains and matrices of polynomials*; **J. B. Wagoner**, *Classification of subshifts of finite type*; **R. F. Williams**, *Strong shift equivalence of matrices in $GL(2, \mathbb{Z})$* .

1991 *Mathematics Subject Classification*: 28D99, 54H20; 58F99, 60J10
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Curves, Jacobians, and Abelian Varieties: Proceedings of a Summer Research Conference on the Schottky Problem

Ron Donagi, Editor
Volume 136

This volume contains the proceedings of an AMS-IMS-SIAM Joint Summer Research Conference on the Schottky

Problem, held in June 1990 at the University of Massachusetts at Amherst. The conference explored various aspects of the Schottky problem of characterizing Jacobians of curves among all abelian varieties. Some of the articles study related themes, including the moduli of stable vector bundles on a curve, Prym varieties and intermediate Jacobians, and special Jacobians with exotic polarizations or product structures.

Contents

R. D. M. Accola, *Theta vanishings for some smooth Abelian coverings of Riemann surfaces*; **K. Berry and M. Tretkoff**, *The period matrix of Macbeath's curve of genus seven*; **R. Brooks**, *The continued fractions parameter in the deformation theory of classical Schottky groups*; **R. Donagi**, *The fibers of the Prym map*; **C. J. Earle**, *Some Riemann surfaces whose Jacobians have strange product structures*; **L. Ehrenpreis**, *The Schottky relation in Genus 4*; **H. M. Farkas**, *The trisecant formula and hyperelliptic surfaces*; **J. Fay**, *The non-abelian Szego kernel and theta-divisor*; **G. Gonzalez Diez**, *Theta functions on the boundary of moduli space*; **A. I. Iliev**, *Geometry of the fano threefold of degree 10 of the first type*; **J. Jorgenson**, *Some uses of analytic torsion in the study of Weierstrass points*; **G. R. Kempf**, *A problem of Narasimhan*; **H. H.**

Martens, *On the reduction of Abelian integrals and a problem of H. Hopf*; **M. Mulase**, *Normalization of the Krichever data*; **J. F. X. Ries**, *Splittable Jacobi varieties*; **M. Teixidor-I-Bigas** and **L. W. Tu**, *Theta divisors for vector bundles*.

1991 *Mathematics Subject Classification*: 14H42; 14H40, 14K25, 32G20
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ISRAEL MATHEMATICAL CONFERENCE PROCEEDINGS

R. Rochberg, *A correspondence principle for Toeplitz and Calderon-Toeplitz operators*; **P. A. Shvartsman**, *K-functionals of weighted Lipschitz spaces and Lipschitz selections of multivalued mappings*; **L. V. Veselova** and **N. M. Zobin**, *On a tensor approach to interpolation theory*.

1991 *Mathematics Subject Classification*: 46B70; 41A30, 42C05, 42C10, 46A16, 46A62, 46B42, 46J10, 46M35

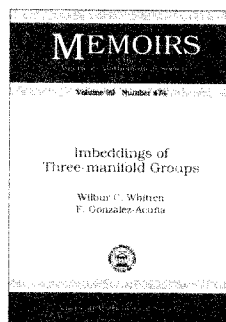
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MEMOIRS OF THE AMS



Imbeddings of Three-manifold Groups

Wilbur C. Whitten and
F. González-Acuña
Volume 99, Number 474

This work deals with the two broad questions of how three-manifold groups imbed in one another and how such imbeddings relate to any corresponding π_1 -injective maps. The focus is on when

a given three-manifold covers another given manifold. In particular, the authors are concerned with 1) determining which three-manifold groups are not cohopfian—that is, which three-manifold groups imbed properly in themselves; 2) finding the knot subgroups of a knot group; and 3) investigating when surgery on a knot K yields lens (or “lens-like”) spaces and how this relates to the knot subgroup structure of $\pi_1(S^3 - K)$. The authors use the formulation of a deformation theorem for π_1 -injective maps between certain kinds of Haken manifolds and develop some algebraic tools.

Contents

Deformation theorems; Cohopficity; Coverings between knot exteriors; Subgroups of finite index; Knot subgroups of torus-knot groups; Depth, and loose and tight subgroups; Knot subgroups of knot groups.

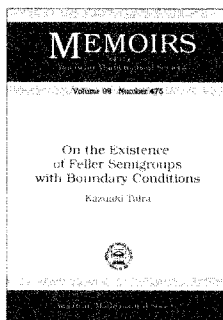
1991 *Mathematics Subject Classification*: 55N99, 57M05, 57M10, 57M25, 57N10, 57N35

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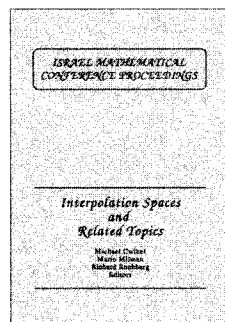


On the Existence of Feller Semigroups with Boundary Conditions

Kazuaki Taira
Volume 99, Number 475

This monograph provides a careful and accessible exposition of functional analytic methods in stochastic analysis. The author focuses on the relationship among three subjects in analysis: Markov

processes, Feller semigroups, and elliptic boundary value problems. The approach here is distinguished by the author's extensive use of the theory of partial differential equations. Filling a mathematical gap between textbooks on Markov processes and recent developments in



Interpolation Spaces and Related Topics

Michael Cwikel,
Mario Milman, and
Richard Rochberg, Editors
Volume 5

This book contains the proceedings of the International Workshop on Interpolation Spaces and Related Topics, held at Technion in Haifa, Israel, in the

summer of 1990. Interpolation spaces have their roots in the classical interpolation theorems of Marcikiewicz and Riesz-Thorin. In the last three decades, the study of these spaces has developed into an extensive theory with applications in several fields, including harmonic analysis, partial differential equations, and geometry of Banach spaces. Substantial contributions have come from both sides of the former “Iron Curtain”, and the Haifa Workshop was the first time that sizable contingents of experts from East and West could meet and interact.

The twenty-one research papers in this volume reflect recent developments at the frontier of research in several directions in interpolation theory. In addition, the volume provides a concise and convenient summary of interesting but hitherto less well-known work in interpolation from the Russian schools of Yaroslavl and Kazan. One highlight is an extensive list of unsolved problems in interpolation theory, including contributions from a number of experts who were unable to attend the workshop. This volume was published by Bar-Ilan University and is distributed by the AMS.

Contents

A. Bernal, *Some results on complex interpolation of T_q^p spaces*; **Y. A. Brudnyi**, *Some recent general results in interpolation theory*; **M. J. Carro** and **J. Cerdà**, *On the interpolation of analytic families of operators*; **F. Cobos** and **I. Resina**, *An interpolation formula for approximation spaces*; **W. C. Connnett** and **A. L. Schwartz**, *Interpolation of Banach algebras*; **M. Cwikel** and **A. Sharif**, *Complex interpolation spaces generated by the Gagliardo completion of an arbitrary Banach couple*; **E. Hernández** and **J. Soria**, *Interpolation theorems of some weighted quasi-Banach spaces*; **B. Jawerth** and **M. Milman**, *New results and applications of extrapolation theory*; **B. Jawerth** and **M. Milman**, *Wavelets and best approximation in Besov spaces*; **N. J. Kalton**, *On a question of Pisier*; **N. J. Kalton**, *Remarks on lattice structure in ℓ_p and L_p when $0 < p < 1$* ; **R. A. Kerman**, *Convergence of approximate identities in weighted Lebesgue spaces*; **M. Mastyló**, *Interpolation functors commuting with direct products*; **M. Milman**, *Local operators vs Lorentz-Marcinkiewicz spaces*; **I. Ya. Novikov**, *Inner estimates*; **B. P. Osilenker**, *The generalized Δ -translation in a multiple orthogonal polynomial system*; **V. I. Ovchinnikov**, *On the description of interpolation orbits in couples of L_p spaces when they are not described by the K -method*; **Y. Raynaud**, *On Lorentz-Sharpely spaces*;

analysis, this work describes a powerful method capable of extensive further development. The book would be suitable as a textbook in a one-year, advanced graduate course on functional analysis and partial differential equations, with emphasis on their strong interrelations with probability theory.

Contents

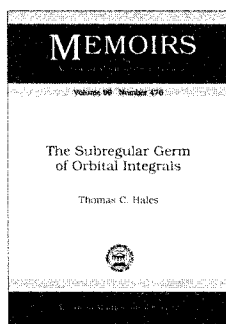
Introduction and results; Theory of Feller semigroups; Theory of pseudo-differential operators; Proof of Theorem 1; Proof of Theorem 2; Appendix the maximum principle.

1991 *Mathematics Subject Classification*: 35J25, 47D07; 47D05, 60J35, 60J60
ISBN 0-8218-2535-6, LC 92-18061, ISSN 0065-9266

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The Subregular Germ of Orbital Integrals

Thomas C. Hales

Volume 99, Number 476

Langlands theory predicts deep relationships between representations of different reductive groups over a local or global field. The trace formula attempts to reduce many such relationships to problems concerning conjugacy classes and integrals over conjugacy classes

(orbital integrals) on p -adic groups. It is possible to reformulate these problems as ones in algebraic geometry by associating a variety Y to each reductive group. Using methods of Igusa, the geometrical properties of the variety give detailed information about the asymptotic behavior of integrals over conjugacy classes. This monograph constructs the variety Y and describes its geometry. As an application, the author uses the variety to give formulas for the leading terms (regular and subregular germs) in the asymptotic expansion of orbital integrals over p -adic fields. The final chapter shows how the properties of the variety may be used to confirm some predictions of Langlands theory on orbital integrals, Shalika germs, and endoscopy.

Contents

Basic constructions; Coordinates and coordinate relations; Groups of rank two; The subregular spurious divisor; The subregular fundamental divisor; Rationality and characters; Applications to endoscopic groups.

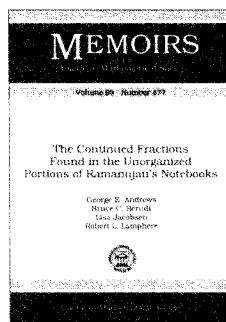
1991 *Mathematics Subject Classification*: 20G25; 12B27, 22E35

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The Continued Fractions Found in the Unorganized Portions of Ramanujan's Notebooks

George E. Andrews, Bruce C. Berndt, Lisa Jacobsen, and Robert L. Lamphere

Volume 99, Number 477

Among his thirty-three published papers, Ramanujan had only one continued fraction, the Rogers-Ramanujan continued fraction. However, his notebooks contain over 100 results on continued fractions. At the end of his second notebook are 100 pages of unorganized material, and the third notebook comprises thirty-three pages of disorganized results. In these 133 pages of material are approximately sixty theorems on continued fractions, most of them new results. In this monograph, the authors discuss and prove each of these theorems. Aimed at those interested in Ramanujan and his work, this monograph will be of special interest to those who work in continued fractions, q -series, special functions, theta-functions, and combinatorics. The work is likely to be of interest to those in number theory as well. The only required background is some knowledge of continued fractions and a course in complex analysis.

1991 *Mathematics Subject Classification*: 30B70, 40A15

ISBN 0-8218-2538-0, LC 92-18059, ISSN 0065-9266

71 pages (softcover), September 1992

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The Scope and History of Commutative and Noncommutative Harmonic Analysis

History of Mathematics, Volume 5 • George W. Mackey, Editor

This volume presents a sweeping view of the importance, utility, and beauty of harmonic analysis and its connections to other areas of mathematics and science.

Aimed at mathematicians in all areas as well as mathematically-oriented theoretical physicists and advanced graduate students, Mackey's book is not directed to specialists but is intended to help specialists learn about fields other than their own and about the relationships among fields. Readers will appreciate this book for its lucid expository presentations and for its wide-ranging treatment of the subject. This volume is published jointly with the London Mathematical Society.

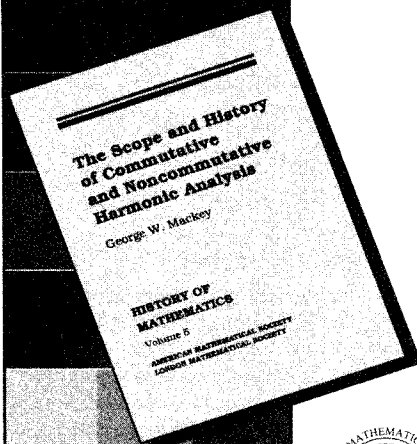
1991 *Mathematics Subject Classification*: 00; 01, 11, 22, 81

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AMS Reports and Communications

Statistics on Women Mathematicians Compiled by the AMS

At its August 1985 meeting, the Council of the AMS approved a motion to regularly assemble and report in the *Notices* information on the relative numbers of men versus women in at least the following categories: membership in the AMS; invited hour addresses at AMS meetings; speakers at special sessions at AMS meetings; and members of editorial boards of AMS journals.

It was subsequently decided that this information would be gathered by determining the sex of the individuals in the above categories based on name identification and that additional information on the number of Ph.D.'s granted to

women would also be collected using the AMS-MAA Annual Survey. Since name identification was used, the information for some categories necessitated the use of four classifications:

Male: names that were obviously male;

Female: names that were obviously female;

Unknown: names that could not be identified as clearly male or female (e.g., only initials given); and

Foreign: foreign names that could not be identified as clearly male or female.

The following is the seventh reporting of this information. Updated reports will appear annually in the *Notices*.

Members of the AMS Residing in the U.S.

Male:	14,423	72%
Female:	3,398	17%
Unknown:	1,776	9%
Foreign:	468	2%
Total checked:	20,065	

Invited Hour Address Speakers at AMS Meetings (1982-1991)

Male:	353	92%
Female:	32	8%
Unknown:	1	0%
Foreign:	0	0%
Total checked:	386	

Speakers at Special Sessions at AMS Meetings (1987-1991)

Male:	4,051	85%
Female:	361	8%
Unknown:	167	3%
Foreign:	204	4%
Total checked:	4,783	

Trustees and Council Members

	1991	1990	1989	1988
Total:	50	52	53	56
Male:	45 90%	45 87%	46 87%	46 82%
Female:	5 10%	7 13%	7 13%	10 18%

Members of Editorial Boards of AMS Journals

	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982
Total:	169	183	194	161	133	109	102	93	90	83
Male:	156 92%	171 93%	182 94%	148 92%	125 94%	104 95%	94 92%	85 91%	84 93%	77 93%
Female:	13 8%	12 7%	11 6%	13 8%	8 6%	5 5%	8 8%	8 9%	6 7%	6 7%

Ph.D.s Granted to U.S. Citizens

	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982
Total:	461	401	411	363	362	386	396	433	455	519
Male:	349 76%	312 78%	313 76%	287 79%	289 80%	304 79%	315 80%	346 80%	366 80%	431 83%
Female:	112 24%	89 22%	98 24%	76 21%	73 20%	82 21%	81 20%	87 20%	89 20%	88 17%

Officers and Committee Members

Numbers to the left of headings are used as points of reference in a index to AMS committees which follows this listing. Primary and secondary headings are:

- 1 Officers
 - 1.1 Liaison Committee
- 2 Council
 - 2.1 Executive Committee of the Council
- 3 Board of Trustees
- 4 Committees
 - 4.1 Committees of the Council
 - 4.2 Editorial and Communications Committees
 - 4.3 Committees of the Board of Trustees
 - 4.4 Internal Organization of the AMS
 - 4.5 Program and Meetings
 - 4.6 Status of the Profession
 - 4.7 Prizes and Awards
 - 4.8 Institutes and Symposia
 - 4.9 Joint Committees
- 5 Representatives
- 6 Index

Terms of members expire on January 31 following the year given unless otherwise specified.

1. Officers

President	Michael Artin	1992
President-Elect	Ronald L. Graham	1992
Vice-Presidents	Lenore Blum	1992
	Chandler Davis	1993
	Linda Keen	1994
Secretary	Robert M. Fossum	1992
Associate Secretaries	Joseph A. Cima	1992
	W. Wistar Comfort	1992
	Andy Roy Magid	1993
	Lance W. Small	1993
Treasurer	Franklin P. Peterson	1992
Associate Treasurer	Steve Armentrout	1992

1.1. Liaison Committee

All members of this committee serve *ex officio*.

Chair	Michael Artin	
	Robert M. Fossum	
	Franklin P. Peterson	

2. Council

2.0.1. Officers of the AMS

President	Michael Artin	1992
President-Elect	Ronald L. Graham	1992
Vice-Presidents	Lenore Blum	1992
	Chandler Davis	1993
	Linda Keen	1994
Secretary	Robert M. Fossum	1992
Associate Secretaries*	Joseph A. Cima	1992

Treasurer
Associate
Treasurer

W. Wistar Comfort	1992
Andy Roy Magid	1993
Lance W. Small	1993
Franklin P. Peterson	1992
Steve Armentrout	1992

2.0.2. Representatives of Committees

American Journal of Mathematics	M. Salah Baouendi	1992
Bulletin	Frank S. Quinn	1993
Colloquium	G. D. Mostow	1993
Executive Committee	Arthur M. Jaffe	1994
Executive Committee	Hugo Rossi	1992
Journal of the AMS	Wilfried Schmid	1993
Committee to Monitor Problems in Communication	Judy Green	1992
Mathematical Reviews	B. A. Taylor	1992
Mathematical Surveys and Monographs	Marc A. Rieffel	1994
Mathematics of Computation	Walter Gautschi	1992
Proceedings	Irwin Kra	1994
Science Policy Committee	Frank W. Warner III	1993
Transactions and Memoirs	James E. Baumgartner	1995

2.0.3. Members-at-Large

Sheldon Axler	1992	Rebecca A. Herb	1994
Joan S. Birman	1992	Elliott H. Lieb	1994
Ruth M. Charney	1994	Carl Pomerance	1992
Charles Herbert Clemens	1992	Gunther A. Uhlmann	1994
Carl C. Cowen, Jr.	1994	Steven H. Weintraub	1993
David A. Cox	1993	Ruth J. Williams	1993
John M. Franks	1993	Shing-Tung Yau	1992
Frank Gilfeather	1993		

2.1. Executive Committee of the Council

Chair	Michael Artin	<i>ex officio</i>
	M. Salah Baouendi	1993
	Joan S. Birman	1995
	Robert M. Fossum	<i>ex officio</i>
	Ronald L. Graham	<i>ex officio</i>
	Arthur M. Jaffe	1994
	Hugo Rossi	1992

3. Board of Trustees

Steve Armentrout	<i>ex officio</i>
Michael Artin	<i>ex officio</i>
Frederick W. Gehring	1992

* Only one Associate Secretary at a time is a voting member of the Council, namely the cognizant Associate Secretary for the scientific sessions.

Officers and Committee Members

Secretary	Maria M. Klawe	1996
	M. Susan Montgomery	1995
Chair	Franklin P. Peterson	<i>ex officio</i>
	John C. Polking	1994
	Paul J. Sally, Jr.	1993

4. Committees

4.1. Committees of the Council

Standing Committees

4.1.1. Editorial Boards

Chair	Linda Keen	1992
	Richard James Milgram	1993
	Barry Simon	1992
	Bhama Srinivasan	1994
	Nolan R. Wallach	1993
	Robert J. Zimmer	1994

4.1.2. Nominating Committee

Chair	Michael Aschbacher	1993
	Daniel M. Burns, Jr.	1994
	Jerry L. Kazdan	1993
	Barbara Lee Keyfitz	1992
	Ray A. Kunze	1992
	Joseph Lipman	1994
	Walter David Neumann	1993
	Robert F. Williams	1992
	Carol S. Wood	1994

Ad Hoc Committee

4.1.3. Nominating Procedures

Chair	Chandler Davis	
	Robert M. Fossum	<i>ex officio</i>
	Frank L. Gilfeather	
	Jerry L. Kazdan	
	Ray A. Kunze	
	James W. Maxwell	<i>ex officio</i>
	Ruth J. Williams	

4.2. Editorial and Communications Committees

4.2.1. Abstracts Editorial Committee

All members of this committee serve *ex officio*.

Chair	Joseph A. Cima	
	W. Wistar Comfort	
	Robert M. Fossum	
	Andy Roy Magid	
	Lance W. Small	

4.2.2. American Journal of Mathematics, Society's Representatives

Chair	M. Salah Baouendi	1992
		1994

4.2.3. Bulletin (New Series)

Chair	Richard S. Palais	1992
	Murray H. Protter	1994
	Frank S. Quinn	1993

Associate Editors for Research Announcements

Gergory L. Cherlin	1992	Zoltan Furedi	1993
William G. Dwyer	1993	Harry Kesten	1993
Charles L. Epstein	1993	Robert Lazarsfeld	1992
Daniel S. Freed	1993	Paul S. Muhly	1993
Michael D. Fried	1993		

Associate Editors for Research – Expository Papers

Persi W. Diaconis	1992	David A. Vogan, Jr.	1992
Jerry L. Kazdan	1992	Alan D. Weinstein	1992
Barry Mazur	1992	Guido L. Weiss	1992

4.2.4. Collected Works

Chair	Richard A. Askey	1992
	Joan S. Birman	1992
	R. Keith Dennis	1992
	Steve Gersten	1992
	Dennis P. Sullivan	1992

4.2.5. Colloquium

Chair	Luis A. Caffarelli	1994
	H. Jerome Keisler	1992
	G. D. Mostow	1993

4.2.6. Committee to Monitor Problems in Communication

Chair	William Abikoff	1993
	Jon Barwise	1992
	James H. Curry	1994
	Judy Green	1992
	William H. Jaco	<i>ex officio</i>
	Brian Markus	1994
	Diane Meuser	1993

4.2.7. Contemporary Mathematics

Chair	Richard W. Beals	1994
	Craig Huneke	1992
	Clark Robinson	1994
	Linda Preiss Rothschild	1992
	Peter M. Winkler	1994

4.2.8. Graduate Studies in Mathematics

	Ronald R. Coifman	1992
	William Fulton	1992
	Lance W. Small	1992
		1992

4.2.9. Journal of the AMS

Chair	H. Blaine Lawson, Jr.	1994
	Robert D. MacPherson	1993
	Richard B. Melrose	1993
	Andrew M. Odlyzko	1994
	Wilfried Schmid	1993

Associate Editors

James G. Arthur	1992	Andrew J. Majda	1992
Persi W. Diaconis	1994	Dusa McDuff	1994
Gerd Faltings	1991	Hugh L. Montgomery	1993
Charles L. Fefferman	1992	Paul H. Rabinowitz	1991
Michael H. Freedman	1993	Marina Ratner	1994
Daniel Friedan	1991	Richard Schoen	1994
Ronald L. Graham	1992	Richard P. Stanley	1994
Joe Harris	1993	W. Hugh Woodin	1993
Hendrik W. Lenstra, Jr.	1991		

4.2.10. Mathematical Reviews

Chair	Wendell H. Fleming	1994
	John L. Selfridge	1994
	B. A. Taylor	1992
	Hans F. Weinberger	1993

4.2.11. Mathematical Surveys and Monographs

	Robert E. Greene	1992
	David W. McLaughlin	1994
Chair	Marc A. Rieffel	1994
	Bhama Srinivasan	1993

4.2.12. Mathematics of Computation

Chair	Walter Gautschi	1992
	Andrew M. Odlyzko	1994
	Frank W. J. Olver	1993
	Lars B. Wahlbin	1992

Associate Editors

James Bramble	1994	Carl Pomerance	1994
E. W. Cheney	1994	René Schoof	1992
James W. Demmel	1994	Ridgway Scott	1992
Eugene Isaacson	1992	Daniel Shanks	1993
Heinz-Otto Kreiss	1993	Frank Stenger	1992
James N. Lyness	1993	Hans J. Stetter	1994
Harald Niederreiter	1993	G. W. Stewart	1992
Jorge J. Nocedal	1993	Nico M. Temme	1992
Syvert P. Nørsett	1993	Vidar C. Thomée	1994
John Osborn	1992	Hugh C. Williams	1994
Stanley J. Osher	1992	John W. Wrench, Jr.	1993

4.2.13. Notices

	John S. Bradley	<i>ex officio</i>
	Michael G. Crandall	1992
	Amassa C. Fauntleroy	1994
Chair	Robert M. Fossum	<i>ex officio</i>
	Carolyn S. Gordon	1994
	D. J. Lewis	1992
	Ridgway Scott	1994
	Robert E. L. Turner	1992

Associate Editors

Special Articles	Ronald L. Graham
	Jeffrey C. Lagarias

4.2.14. Proceedings

Vice-Chair	William W. Adams	1992
	Dale Alspach	1995
	J. Marshall Ash	1992
	Maurice Auslander	1992
	Albert Baernstein	1995
	Eric Bedford	1995
	Andreas Blass	1992
	Andrew M. Bruckner	1993
	Chris Croke	1995
	Clifford J. Earle, Jr.	1992
	Eric M. Friedlander	1995
	Theodore W. Gamelin	1994
	James G. Glimm	1995
	Roe Goodman	1995
	Thomas Goodwillie	1995
	Lawrence F. Gray	1993
	Dennis A. Hejhal	1995
	Palle E. T. Jorgensen	1992
	Jeff Kahn	1993
	Barbara Lee Keyfitz	1995
Chair	Irwin Kra	1994
	Peter W. K. Li	1994
	Wei Y. Loh	1995
	Joseph S. B. Mitchell	1995
	M. Susan Montgomery	1995
	Charles Pugh	1994
	David Sharp	1995
	Hal L. Smith	1995
	Ronald M. Solomon	1994
	Ronald J. Stern	1995

Franklin Tall	1993
John Trangenstein	1995
James E. West	1995

4.2.15. Proceedings of Symposia in Applied Mathematics

Chair	Alexandre J. Chorin	1991
	Björn E. J. Dahlberg	1991
	Ronald L. Graham	1992

4.2.16. Transactions and Memoirs

Chair	Avner D. Ash	1994
	James E. Baumgartner	1995
	Robert L. Bryant	1995
	Sun-Yung Alice Chang	1994
	Ralph L. Cohen	1992
	Richard Durrett	1994
	Philip J. Hanlon	1995
	David Jerison	1994
	Wen-Ching Winnie Li	1995
	John J. Mallet-Paret	1995
	Judith D. Sally	1993
	Peter B. Shalen	1995
	Masamichi Takesaki	1993

4.2.17. Translation from Chinese

	Sun-Yung Alice Chang
	S.-Y. Cheng
Chair	Tsit-Yuen Lam
	Tai-Ping Liu
	Chung-Chun Yang

4.2.18. Translation from Japanese

	Shoshichi Kobayashi
Chair	Katsumi Nomizu

Standing Committees

4.2.19. Electronic Publications

	Nancy Anderson	1993
	Keith J. Devlin	1992
Chair	John M. Franks	1994
	Maria M. Klawe	1994
	Frank S. Quinn	1993
Consultant	David Rodgers	

4.2.20. History of Mathematics

	Charles W. Curtis	1993
Chair	Harold M. Edwards	1994
	Guido Weiss	1994

4.2.21. Reprinted Books

	Eugenio Calabi
	Charles W. Curtis
Chair	Oscar S. Rothaus

4.2.22. University Lecture Series

	Theodore W. Gamelin
	Donald S. Ornstein
	Leonard L. Scott

Ad Hoc Committee

4.2.23. Member Publications

	Michael Artin	<i>ex officio</i>
	Sheldon Axler	
	John H. Ewing	
	John M. Franks	
	Judy Green	

William H. Jaco
Haynes R. Miller
Richard S. Palais
John C. Polking
Hugo Rossi
Carol S. Wood

ex officio

4.3. Committees of the Board of Trustees

4.3.1. Agenda and Budget

All members of this committee serve *ex officio*.

Steve Armentrout
Michael Artin
Robert M. Fossum
Franklin P. Peterson
Hugo Rossi
Paul J. Sally, Jr.

4.3.2. Appeals Committee on Discounted Subscriptions

Consultant Carol-Ann Blackwood
Chair William H. Jaco
Morton Lowengrub
Franklin P. Peterson
Paul J. Sally, Jr.
Consultant B. A. Taylor

ex officio

4.3.3. Audit

All members of this committee serve *ex officio*.

Franklin P. Peterson
Paul J. Sally, Jr.

4.3.4. Computer Operations and Facilities, Visiting Committee on

Chair Maria M. Klawe
Richard Mandelbaum
Jill P. Mesirov
Peter J. Weinberger

ex officio
1992
1994
1993

4.3.5. Corporate Relations

Chair Ramesh A. Gangolli
Maria M. Klawe
Oscar S. Rothaus

4.3.6. Endowment

Chair Andrew M. Gleason
W. Ted Martin
Cathleen S. Morawetz

4.3.7. Investment

Chair Steve Armentrout
Frederick W. Gehring
Franklin P. Peterson
T. Benny Rushing

ex officio
ex officio
ex officio
1994

4.3.8. Legal Aid

Chair Steve Armentrout
Todd Dupont
Murray Gerstenhaber

4.3.9. Long Range Planning

All members of this committee serve *ex officio*.

Chair M. Salah Baouendi
Robert M. Fossum
William H. Jaco
Arthur M. Jaffe
Franklin P. Peterson
Paul J. Sally, Jr.

4.3.10. Membership

Consultant M. Salah Baouendi
Carol-Ann Blackwood
Susan Friedlander
Chair Frederick W. Gehring
Wen-Ching Winnie Li
Hugo Rossi

1993
1992
1992
1993
1994

4.3.11. The Publication Program

Chair Steve Armentrout
Robert L. Devaney
Robert M. Fossum
Eric Friedlander
Ramesh A. Gangolli
William H. Jaco
Elliott H. Lieb
Andrew M. Odlyzko
John C. Polking
Paul J. Sally, Jr.
B. A. Taylor

1993
1992
ex officio
1992
1992
ex officio
1994
1992
ex officio
ex officio
1992

4.3.12. Salaries

All members of this committee serve *ex officio*.

Chair Steve Armentrout
Franklin P. Peterson
John C. Polking
Paul J. Sally, Jr.

4.3.13. Staff and Services

Chair Steve Armentrout
Franklin P. Peterson
Paul J. Sally, Jr.

ex officio
ex officio

Ad Hoc Committee

4.3.14. Institutional Membership

Consultant Carol-Ann Blackwood
Ramesh A. Gangolli
Chair Frederick W. Gehring
Jeremy J. Soldevilla
William A. Veech

ex officio

4.4. Internal Organization of the American Mathematical Society

Standing Committees

4.4.1. Archives

Chair Andrew M. Gleason
Franklin P. Peterson
Everett Pitcher

4.4.2. Committee on Committees

Chair James G. Arthur
Michael Artin
M. Salah Baouendi
Lenore Blum
Robert M. Fossum
John M. Franks
Ronald L. Graham
Tsit-Yuen Lam
Joshua A. Leslie
George R. Sell
James D. Stasheff
William Yalas Velez
Sylvia M. Wiegand

1992
ex officio
1992
1992
ex officio
1992
ex officio
1992
1992
1992
1992
1992
1992

4.4.3. Subcommittee to Study the Committee Structure

	Steve Armentrout	
	Michael Artin	<i>ex officio</i>
	Robert M. Fossum	<i>ex officio</i>
	William H. Jaco	<i>ex officio</i>
	Maria M. Klawe	
	Tsit-Yuen Lam	
	Joshua A. Leslie	
	Ann Renauer	
	William Yslas Velez	
	Steven H. Weintraub	
Chair	Sylvia M. Wiegand	

4.4.4. Library Committee

Co-chair	Nancy Anderson	1994
	Richard A. Askey	1993
	R. Keith Dennis	1994
	Robert S. Doran	1993
	Dorothy McGarry	1994
Co-chair	James Rovnyak	1994
	Mary Ann Southern	1994
	Jack Weigel	1993

Ad Hoc Committees

4.4.5. Applications of Mathematics

Chair	Frederick J. Almgren, Jr.
	Jerry L. Bona
	Hermann Flaschka
	Barbara Lee Keyfitz
	David Mumford
	Ivar Stakgold
	Hans F. Weinberger

4.4.6. 1991 Election Tellers

Leo P. Comerford, Jr.
Robert E. Megginson

4.5. Program and Meetings

Standing Committees

4.5.1. Program Committee for National Meetings

	Spencer Bloch	1992
	Hermann Flaschka	1994
	Robert M. Fossum	<i>ex officio</i>
	H. W. Lenstra	1994
	Dusa McDuff	1993
Chair	Nancy K. Stanton	1993
	Mary F. Wheeler	1994

4.5.2. Short Course Subcommittee

Chair	Stefan Burr	1992
	Lisl Novak Gaal	1992
	Jeffery C. Lagarias	1994
	Patrick D. McCray	1994
	James J. Tattersall	1993
		1994
		1994

4.5.3. Central Section Program Committee

Chair	Rodrigo Banuelos	1993
	John M. Franks	1992
	Julia Knight	1993
	Andy Roy Magid	<i>ex officio</i>
	Jang-Mei Wu	1992

4.5.4. Eastern Section Program Committee

	Roy Adler	1993
	W. Wistar Comfort	<i>ex officio</i>
	John C. Moore	1992
	Lesley M. Sibner	1992
Chair	Gregg J. Zuckerman	1993

4.5.5. Southeastern Section Program Committee

	Joseph A. Cima	<i>ex officio</i>
	Sue E. Goodman	1992
	Jean Larson	1993
Chair	Carl Pomerance	1992
	Donald St.P. Richards	1993

4.5.6. Western Section Program Committee

	F. Michael Christ	1993
	Janos Kollar	1992
	Robert R. Phelps	1993
	Lance W. Small	<i>ex officio</i>
Chair	Ronald J. Stern	1992

4.5.7. Agenda for Business Meetings

Chair	M. Salah Baouendi	1992
	Robert M. Fossum	
	Carol L. Walker	1992

4.5.8. Gibbs Lecturer for 1993 and 1994, Committee to Select

	Michael Atiyah
	Cathleen S. Morawetz
	Michael O. Rabin
Chair	Thomas Spencer

4.5.9. Progress in Mathematics

Chair	Hyman Bass	1992
	John B. Friedlander	1994
	Peter W. K. Li	1993
	Haynes R. Miller	1993
	James B. Serrin	1994

Ad Hoc Committees

4.5.10. Arnold Ross Lecture Series Committee

Chair	Harvey B. Keynes
	Paul J. Sally, Jr.
	Jean E. Taylor

4.5.11. Meetings Committee

	Lenore Blum
Consultant	H. Hope Daly
Chair	Andy Roy Magid
	Nancy K. Stanton
	Ruth J. Williams

4.6. Status of the Profession

Standing Committees

4.6.1. Academic Freedom, Tenure, and Employment Security

	Josefina Alvarez	1993
	Leon Brown	1994
	Ellis Kolchin	1992
	Lawrence E. Morris	1993
Chair	Mary Ellen Rudin	1992
	Gail S. Young	1992

4.6.2. Academic Review

	Frederick W. Gehring
	Frank L. Gilfeather
	Andrew M. Gleason
Chair	J. K. Goldhaber

4.6.3. Education

	Michael Artin	<i>ex officio</i>
	Ramesh A. Gangolli	1992
	Andrew M. Gleason	1992
	Fern Y. Hunt	1992
	William H. Jaco	<i>ex officio</i>
	Harvey B. Keynes	1992
	Don J. Lewis	1992
	Richard A. Tapia	1992
	Alan C. Tucker	1993
	Frank W. Warner III	<i>ex officio</i>

4.6.4. Human Rights of Mathematicians

	Raymundo Bautista	1994
	Sufian Y. Hussein	1994
	Wen-Ching Winnie Li	1993
	Cora S. Sadosky	1992
	Alice T. Schafer	1993
	Jonathan M. Wahl	1994
	Steven H. Weintraub	1992
	Hung-Hsi Wu	1993

4.6.5. Liaison Committee on Education in Mathematics

	John A. Dossey
	Melvin Hochster
	Rogers J. Newman
	Louise A. Raphael
	Paul J. Sally, Jr.
	James D. Stasheff
	Lynn Arthur Steen

4.6.6. Pi Mu Epsilon Liaison Committee

	David W. Ballew	1993
	Lynne M. Butler	1993
	Mary B. Martin	1994
	Eileen Poiani	1992
	Bruce Reznick	1993
	De Witt Sumners	1994

4.6.7. Professional Ethics

	Leonard D. Berkovitz	1993
	Donald J. Lewis	1994
	Albert Marden	1994
	Everett Pitcher	1992
	Judith Roitman	1993

4.6.8. Science Policy

	Michael Artin	<i>ex officio</i>
	James A. Donaldson	1993
	Eric M. Friedlander	1994
	Ramesh A. Gangolli	<i>ex officio</i>
	Ronald L. Graham	<i>ex officio</i>
	Rhonda J. Hughes	1993
	William H. Jaco	<i>ex officio</i>
	Linda Keen	1993
	Joseph J. Kohn	1992
	Joel L. Lebowitz	1992
	William James Lewis	1994
	Michael C. Reed	1992
	Linda Preiss Rothschild	1994
	Paul J. Sally, Jr.	1992
	Frank W. Warner III	1993
	Mary F. Wheeler	1992
		1994

4.6.9. Service to Mathematicians in Developing Countries

Chair	Raymond G. Ayoub
	James A. Donaldson
	James Eells
	Donald M. Hill

Ad Hoc Committees

4.6.10. Advisory Committee on Former Soviet Union Mathematics

Chair	Michael Artin	
	William H. Jaco	<i>ex officio</i>
	Robert D. MacPherson	
	Cathleen S. Morawetz	
	John C. Polking	
	Linda Preiss Rothschild	
	Daniel Stroock	

4.6.11. Advisory Committee on Professional Ethics

	Murray Gerstenhaber
	Frank L. Gilfeather
	Judy Green
	Linda Keen
	Elliott H. Lieb

4.6.12. CAFTES (Academic Freedom, Tenure and Employment Security) and COPE (Committee on Professional Ethics)

Chair	Joan S. Birman
	Frank L. Gilfeather
	Elliott H. Lieb

4.6.13. Cooperation with Latin American Mathematicians

Chair	Charles Herbert Clemens
	Samuel Gitler
	Carlos E. Kenig
	Joseph J. Kohn
	Horacio A. Porta
	Cora S. Sadosky

4.6.14. Coordinating Committee for the Doctoral Program in Mathematics

Chair	R. Creighton Buck
	Franklin P. Peterson
	Murray H. Protter

4.6.15. Employment Task Force

	S.-Y. Cheng	
	Ronald M. Davis	
	Helen G. Grundman	
	D. J. Lewis	
	Bernard L. Madison	
	James W. Maxwell	<i>ex officio</i>
	Donald E. McClure	
	Calvin C. Moore	
	Carol S. Wood	

4.6.16. Soviet Mathematicians, Committee to Study Relations with

Chair	Chandler Davis
	Robert D. MacPherson
	Hugo Rossi
	Lance W. Small

4.7. Prizes and Awards

Standing Committees

4.7.1. Award for Public Service, Committee to Select the Winner of

Chair	William Browder	1995
	Kenneth M. Hoffman	1996
	Robert M. Fossum	1992
	John C. Polking	1994
	David P. Roselle	1993

4.7.2. Centennial Fellowships

Terms expire on June 30

Chair	Richard M. Hain	1993
	Douglas A. Lind	1993
	Henry Pinkham	1993
	Peter Sarnak	1994
	Birgit Speh	1994
	Lai-Sang Young	1994

4.7.3. National Awards and Public Representation

Chair	Michael Artin	<i>ex officio</i>
	Joan S. Birman	1993
	Robert M. Fossum	<i>ex officio</i>
	Ronald L. Graham	<i>ex officio</i>
	Richard S. Palais	1993

4.7.4. Subcommittee on Appointments of the Committee on National Awards and Public Representation

Chair	Robert M. Fossum	<i>ex officio</i>
	Irwin Kra	
	John C. Polking	

4.7.5. Satter Prize for 1993, Committee to Select the Winner of the

Chair	Joan S. Birman	1992
	Dusa McDuff	1993
	Alan D. Weinstein	1993

4.7.6. Steele Prizes

Terms expire on June 30

Chair	Eugenio Calabi	1995
	Sylvain E. Cappell	1993
	Vaughan F. R. Jones	1994
	Harry Kesten	1993
	Joseph J. Kohn	1993
	Robert P. Langlands	1995
	Paul Rabinowitz	1995
	Jane Cronin Scanlon	1994
	Jean Taylor	1994

Ad Hoc Committees

4.7.7. AMS Prizes and Awards

Chair	Joan S. Birman	
	Frederick W. Gehring	
	Ronald L. Graham	
	Joseph J. Kohn	
	Gian Carlo Rota	
	Joseph L. Taylor	

4.7.8. Automatic Theorem Proving, Committee to Recommend Winners of Prizes for

Chair	David Mumford	
	Jacob T. Schwartz	
	John L. Selfridge	

4.7.9. Cole Prize, Committee to Select the Winner of

Chair	Gerd Faltings	
	Wolfgang Schmidt	
	Harold M. Stark	

4.8. Institutes and Symposia

Standing Committee

4.8.1. Liaison Committee with AAAS

	Efraim P. Armendariz	<i>ex officio</i>
	Alfred W. Hales	1993
	Raymond Johnson	<i>ex officio</i>
	Philip C. Kutzko	1993
	Louise A. Raphael	1993
	V. Frederick Rickey	<i>ex officio</i>
	M. Beth Ruskai	1993
	Chih-Han Sah	<i>ex officio</i>
	Melvin Thornton	<i>ex officio</i>

4.8.2. Summer Institutes and Special Symposia

Terms expire on February 28

Chair	Donald L. Burkholder	1995
	Lawrence Craig Evans	1994
	Melvin Hochster	1995
	Nicholas Katz	1993
	Brian Parshall	1993
	Francois Treves	1993
	Edward Witten	1994

4.9. Joint Committees

4.9.1. AMS-AAAS-MAA Committee on Opportunities in Mathematics for Underrepresented Minorities

Chair	Sylvia T. Bozeman	1992
	Claudette Bradley	1992
	Johnny E. Brown	1992
	Gloria F. Gilmer	1992
	Shirley Malcom	<i>ex officio</i>
Consultant	Argelia Veléz-Rodriguez	

4.9.2. AMS-ASA-AWM-IMS-MAA-NCTM-SIAM Committee on Women in the Mathematical Sciences

NCTM members' terms expire April 1 of the year given.

Chair	Margaret B. Cozzens (SIAM)	1992
	Marjorie M. Enneking (NCTM)	1992
	Nancy Flournoy (IMS)	1992
	Sue E. Goodman (AMS)	1992
	Joan Hutchinson (AWM)	1993
	Patricia C. Kenschaft (MAA)	1994
	Jeanne W. Kerr (AMS)	1992
	Don J. Lewis (MAA)	1994
	J. Peter May (AMS)	1994
	Anita McDonald (MAA)	1994
	Joyce R. McLaughlin (SIAM)	1993
	Anne Parkhurst (ASA)	
	Magda Peligrad (IMS)	1991
	Linda R. Petzold (SIAM)	1992
	Frances Rosamond (MAA)	1992
	M. Beth Ruskai (AMS)	1992
	Evelyn Silvia (AWM)	1993
	Patricia S. Wilson (NCTM)	1993

4.9.3. AMS-ASL-IMS-SIAM Committee on Translations from Russian and Other Slavic Languages

Chair Peter S. Landweber (AMS) 1992

AMS Subcommittee Members

Consultant V. I. Arnol'd
Luchezar Avramov 1994
Igor Dolgachev 1994
Consultant S. G. Gindikin
Consultant Askol'd Georgievich Khovanskii
Chair Peter S. Landweber (AMS) 1992
Arunas Liulevicius 1993
Consultant N. K. Nikol'skii
Washek Pfeffer 1993

ASL Subcommittee Members

Chair Vladimir Lifschitz 1993
Elliott Mendelson 1992
Grigori Mints 1993
Benjamin F. Wells 1992
Boris I. Zil'ber 1994

IMS Subcommittee Members

Chair M. I. Freidlin
B. Pittel
A. Rukhin
W. J. Studden

4.9.4. AMS-CMS Joint Program Committee

Chair Spencer Bloch (AMS)
David W. Boyd (CMS)
Carl Herz (CMS)
Dusa McDuff (AMS)
Victor P. Snaith (CMS)
Nancy K. Stanton (AMS)

4.9.5. AMS-DMV Liaison Committee

Heinz Bauer
Klaus D. Bierstedt
Albrecht E. Dold
Robert M. Fossum
Dale Husemoller
Bernd Ulrich

4.9.6. AMS-IMS-SIAM Committee on Joint Summer Research Conferences in the Mathematical Sciences

Terms expire on June 30

Chair John A. Burns (SIAM) 1992
Fan R. K. Chung (AMS) 1993
Leonard Evens (AMS) 1993
Martin Golubitsky (SIAM) 1992
Alan F. Karr (AMS) 1996
Peter W. K. Li (AMS) 1993
Stewart B. Priddy (AMS) 1994
Robert J. Serfling (IMS) 1993
Michael Shub (AMS) 1994
Sue Whitesides (AMS) 1996

4.9.7. AMS-LMS Joint Program Committee

Chair William Abikoff (AMS)
Sir Michael Atiyah (LMS)
J. M. Ball (LMS)
Hyman Bass (AMS)
Robert M. Fossum (AMS)
Sir John Kingman (LMS)

4.9.8. AMS-MAA Data Committee

Consultant Edward A. Connors (AMS) 1993
Lincoln K. Durst
John D. Fulton (MAA) 1994
James F. Hurley (AMS) 1994
Charlotte Lin (AMS) 1992
Don O. Loftsgaarden (MAA) 1993
David J. Lutzer (MAA) 1993
James W. Maxwell (AMS) *ex officio*
Chair Donald E. McClure (AMS) 1993
Donald C. Rung (AMS) 1992

4.9.9. AMS-MAA Committee on Teaching Assistants and Part Time Instructors (TA/PTI)

Chair Thomas F. Banchoff (AMS) 1992
Reuben C. Drake (MAA) 1994
Deborah Hughes Hallett (AMS) 1993
John P. Huneke (MAA) 1992
Timothy L. Lance (AMS) 1994
Daniel J. Madden (AMS) 1994
Shelba J. Morman (MAA) 1992
Stephen B. Rodi (MAA) 1994

4.9.10. AMS-MAA Joint Archives Committee

Chair Leonard Gillman
Uta C. Merzbach
Everett Pitcher
Sanford L. Segal

4.9.11. AMS-MAA Joint Meetings Committee

All members of this committee serve *ex officio*.

Consultant H. Hope Daly
Chair Robert M. Fossum
William H. Jaco
Kenneth A. Ross
Marcia P. Sward

4.9.12. AMS-MAA Arrangements Committee for the San Antonio Meeting January 13-16, 1993

Chair Shair Ahmad
Don Bailey
W. Wistar Comfort *ex officio*
William H. Jaco *ex officio*
Carol Redfield
Kenneth A. Ross *ex officio*
David A. Sanchez
Gene Sims
Marcia P. Sward *ex officio*
Betty Travis

4.9.13. AMS-MAA Joint Program Committee for the San Antonio Meeting

Chair Richard A. Askey (MAA)
Hermann Flaschka (AMS)
Roger Horn (MAA)
Richard A. Tapia (AMS)

4.9.14. AMS-MAA Committee on Summer Meetings

Consultant H. Hope Daly (AMS)
Robert M. Fossum (AMS)
Co-chair William H. Jaco (AMS)
Gerald J. Porter (MAA)
Co-chair Kenneth A. Ross (MAA)
John M. Smith (MAA)

4.9.15. AMS-MAA-SIAM Joint Administrative Committee

All members of this committee serve *ex officio*.

	Gerald L. Alexanderson (MAA)
	I. Edward Block (SIAM)
Chair	Robert M. Fossum (AMS)
	Samuel Gubins (SIAM)
	William H. Jaco (AMS)
	Donald L. Kreider (MAA)
	Robert E. O'Malley, Jr. (SIAM)
	Franklin P. Peterson (AMS)
	Marcia P. Sward (MAA)

4.9.16. AMS-MAA-SIAM Joint Committee on Employment Opportunities

	Stanley Benkoski (AMS)	1993
	Peter E. Castro (SIAM)	1992
	Ronald M. Davis (MAA)	1993
	Frank R. Demeyer (AMS)	1994
	James W. Maxwell	<i>ex officio</i>
Chair	S. Brent Morris (MAA)	1994
	Leon H. Seitelman (SIAM)	1994

4.9.17. AMS-MAA-SIAM Joint Policy Board for Mathematics (see 1992 Mathematical Sciences Professional Directory, page 28)

4.9.18. AMS-SIAM Committee on Applied Mathematics

	Marsha J. Berger	1994
	Paul C. Fife	1994
Chair	James M. Hyman	1993
	Andrew J. Majda	1992
	Michael Shub	1993
	Joel Spencer	1992

4.9.19. AMS-SIAM Committee to Select the Winner of the Birkhoff Prize for 1993

Constantine M. Dafermos
Andrew Chi-Chih Yao

4.9.20. AMS-SIAM Committee to Screen Applicants for Graduate Study from the People's Republic of China

David Benney
Robert Bryant

4.9.21. AMS-SIAM-SMB Committee on Mathematics in the Life Sciences

	James W. Curran	1993
	Leah Edelstein-Keshet	1994
	Eric S. Lander	1993
Chair	Marc Mangel	1992
	James Murray	1992
		1994

Ad Hoc Committees

4.9.22. AMS-MAA Committee on Cooperation

	Gerald L. Alexanderson (MAA)	
	Michael Artin (AMS)	<i>ex officio</i>
	Susan Forman (MAA)	
	Robert M. Fossum (AMS)	
	Ramesh A. Gangolli (AMS)	
	Deborah Tepper Haimo (MAA)	<i>ex officio</i>
	William H. Jaco (AMS)	
Staff	Donald L. Kreider (MAA)	
Chair	M. Susan Montgomery (AMS)	

Mary Ellen Rudin (AMS)
David A. Sanchez (AMS)
Andrew Sterrett (MAA)
Marcia P. Sward (MAA)
Alan C. Tucker (MAA)

Staff

4.9.23. AMS-MAA-SIAM Committee on Preparation for College Teaching

Chair	Donald W. Bushaw
	Betty Anne Case
	Robert H. McDowell
	Richard S. Millman
	Robert R. Phelps
	Richard D. Ringeisen
	Stephen B. Rodi
	James G. Simmonds
	Guido L. Weiss

5. Representatives

5.0.1. Advisory Board of the National Translations Center of the John Crerar Library

Ralph P. Boas

5.0.2. American Association for the Advancement of Science

Terms expire on February 21

Section A	Raymond Johnson	1995
Section B	Chih-Han Sah	1995
Section L	V. Frederick Rickey	1995
Section Q	Efraim P. Armendariz	1995
Section T	Melvin Thornton	1995

5.0.3. Commission on Professionals in Science and Technology

Edward A. Connors

5.0.4. Committee on the American Mathematics Competition

Term expires on June 30

Richard P. Stanley 1994

5.0.5. Conference Board of the Mathematical Sciences

Michael Artin 1992

5.0.6. Fulkerson Prize Committee

Alan J. Hoffman

5.0.7. MAA Committee on Guidelines

Donovan H. Van Osdol 1992

5.0.8. MAA Committee on Undergraduate Program in Mathematics

Harvey B. Keynes 1992
Kathy O'Hara 1993

5.0.9. U.S. National Committee on Theoretical and Applied Mechanics

Term expires on October 31

Constantine M. Dafermos 1996

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1991 *Mathematics Subject Classification*: 34; 41

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Miscellaneous

Personals

Rose Ann Dios, of the New Jersey Institute of Technology, was presented the Outstanding Women Scientist award of the Metro New York Chapter of the Association for Women in Science Inc. She was honored for her accomplishments and contributions in the areas of teaching and research in mathematics and for serving as an exceptional role model for other women.

John H. Morrison, of the University of Delaware, Newark, has taken a position as an options research associate at Meredith Overbrook Partners, L.P., Inc., a member of the Cooper-Neff Group.

Paul Rabinowitz, of the University of Wisconsin, Madison, was awarded an honorary degree (Doctorat Honoris Causa) by the University Pierre et Marie Curie (Paris VI) for his exceptional contributions to the analysis of nonlinear problems.

Deaths

Ralph P. Boas, Professor Emeritus of Northwestern University, died on July 25, 1992, at the age of 79. He was a member of the Society for 56 years.

Donald J. Brown, of Saint Albans School, died on January 13, 1992, at the age of 39. He was a member of the Society for 1 year.

Henry L. Garabedian, of Laguna Hills, California, died on May 24, 1992, at the age of 90. He was a member of the Society for 65 years.

Albert E. Heins, of the University of Michigan, died on June 24, 1992, at the age of 79. He was a member of the Society for 52 years.

M. F. Khalifah, of the Teacher Training College, Ruwi, Oman, died on April 2, 1992, at the age of 50. He was a member of the Society for 11 years.

James A. King, of Brooklyn, New York, died on October 27, 1991, at the age of 62. He was a member of the Society for 8 years.

Morris Monsky, of Westborough, Massachusetts, died on June 28, 1990, at the age of 85. He was a member of the Society for 61 years.

J. Ian Richards, of the University of Minnesota, died on June 21, 1992, at the age of 56. He was a member of the Society for 34 years.

G. de B. Robinson, Professor Emeritus of the University of Toronto, died on April 8, 1992, at the age of 85. He was a member of the Society for 59 years.

Bernard W. Roos, of Rancho Santa Fe, California, died on February 29, 1992, at the age of 64. He was a member of the Society for 32 years.

Sergei A. Schelkunoff, Professor Emeritus of Columbia University, died on May 2, 1992. He was a member of the Society for 65 years.

Roland F. Smith, Professor Emeritus of Russell Sage College, died on April 21, 1992, at the age of 75. He was a member of the Society for 44 years.

Frank L. Spitzer, of Cornell University, died on February 1, 1992, at the age of 65. He was a member of the Society for 39 years.

Elmer Tolsted, Professor Emeritus of Pomona College, died on June 23, 1992, at the age of 72. He was a member of the Society for 49 years.

Herbert E. Vaughn, Professor Emeritus of the University of Illinois at Urbana-Champaign, died on April 21, 1992, at the age of 81. He was a member of the Society for 58 years.

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POSITIONS AVAILABLE

ARIZONA

UNIVERSITY OF ARIZONA
Department of Mathematics
Tucson, AZ 85721

The Mathematics Department at the University of Arizona will have tenure-track and postdoctoral positions available beginning Fall 1993.

Tenure-track positions. Excellent research record or potential, strong commitment to teaching required. Fields should complement but not duplicate existing department research strengths in arithmetic geometry, computational science, dynamical systems, differential geometry, nonlinear science, and number theory.

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The Mathematics Department may also have several *visiting positions* for next year.

We encourage early application. **Deadline** date will be **December 15, 1992**, or whenever positions are filled. *Women and minority applicants are especially welcome.* Send application, which should include a letter of interest, curriculum vitae with a list of publications, and a minimum of three (3) letters of recommendation (enclose or arrange to be sent) to:

Personnel Committee
Department of Mathematics
University of Arizona
Tucson, Arizona 85721, U.S.A.

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FLORIDA

UNIVERSITY OF FLORIDA
Department of Mathematics

We invite applications for one or more anticipated tenured or tenure-track appointments in mathematics, effective August 1993. In the case of junior candidates, preference will be given to applicants with postdoctoral experience who have made substantial research contributions beyond the doctoral dissertation. Senior candidates are expected to have demonstrated leadership in research. Applicants should forward a curriculum vitae, a list of publications, and a small number of reprints and/or preprints to

Chair of Search Committee
Department of Mathematics
University of Florida
Gainesville, FL 32611-2082

Candidates should supply evidence of commitment to teaching and arrange for at least three letters of recommendation to be forwarded.

UF is an Affirmative Action Employer, and the Department especially welcomes applications from women and minority candidates. Full consideration will be given to candidates whose materials arrive by December 31, 1992.

ILLINOIS

NORTHWESTERN UNIVERSITY
Department of Mathematics
2033 Sheridan Road
Evanston, Illinois 60208-2730

Applications are invited for one or more anticipated tenure-track positions starting September 1993. Priority will be given to young, exceptional research mathematicians; however, more senior candidates with very exceptional credentials may be considered for a tenured position. Fields of interest within the department include Algebra, Analysis, Dynamical Systems, Probability, Partial Differential Equations, and Topology. Northwestern is an affirmative action, equal opportunity employer committed to fostering a diverse faculty; women and minority candidates are especially encouraged to apply. Candidates should arrange that at least three letters of recommendation be sent to Prof. C. Robinson, Chair, Personnel Committee, Department of Mathematics, Northwestern University, Evanston, Illinois 60208-2730. Alternatively, applications and supporting documentation can be sent via email to "hiring@math.nwu.edu". In order to receive full consideration, applications should be received by January 1, 1993. Hiring is contingent upon eligibility to work in the United States.

NORTHWESTERN UNIVERSITY
Mathematics Department
2033 Sheridan Road
Evanston, Illinois 60208-2730

The Mathematics Department will sponsor an Emphasis Year in probability and stochastic analysis. This program will include two-year assistant professorship positions starting September 1993 and possible visiting positions for more senior mathematicians for part or all of the academic year. Applications should be sent to Professor Mark A. Pinsky at the department address and include a curriculum vitae and three letters of recommendation. In order to ensure full consideration, an application must be received by January 1, 1993. Northwestern University is an affirmative action, equal opportunity employer committed to fostering a diverse faculty; women and minority candidates are especially encouraged to apply. Hiring is contingent upon eligibility to work in the United States.

MARYLAND

THE JOHNS HOPKINS UNIVERSITY
Department of Mathematical Sciences

Applications are invited for 3 anticipated faculty positions within the areas of

1) numerical linear algebra (Senior applicants preferred), 2) statistics, 3) operations research, 4) applied discrete mathematics.

Selection is based on demonstration and promise of excellence in research, teaching, and innovative applications.

Minority and women candidates are encouraged to apply. The Johns Hopkins University

is an Affirmative Action/Equal Opportunity Employer.

Applicants are asked to furnish a curriculum vitae, transcripts (junior applicants only), reprints (if available), a letter describing professional interests and aspirations, and to arrange for three letters of recommendation to:

Prof. John C. Wierman, Chair
Department of Mathematical Sciences
220 Maryland Hall
The Johns Hopkins University
Baltimore, Maryland 21218-2689

Applications are requested by January 15, 1993.

Applicants whose primary research is in algebra, analysis, geometry, logic, number theory, or topology will not be considered.

MASSACHUSETTS

WILLIAMS COLLEGE

Department of Mathematics
Williamstown, Massachusetts 01267

One or possibly two anticipated positions, one of them preferably in statistics, probably at the rank of assistant professor, for Fall 1993. Strong commitment to both teaching and scholarship is essential.

Please have a vita and three letters of recommendation on teaching and research sent to Hiring Committee. Formal evaluation of applications will begin November 15, 1992, and continue until the positions are filled. AA/EEO.

NEW YORK

STATE UNIVERSITY OF NEW YORK AT BUFFALO

The Department of Mathematics anticipates the appointment of several tenured or tenure-track faculty members beginning September 1, 1993. Salary will be competitive. We seek applicants in all areas with excellent research accomplishments/potential and a strong commitment to teaching.

Applicants should send supporting information, including a c.v. with a list of research interests, and have four letters of recommendation sent to:

Search Committee Chairman
Department of Mathematics
SUNY/Buffalo
106 Diefendorf Hall
Buffalo, New York 14214

The deadline for applications is November 1, 1992. Late applications will be considered until positions are filled.

SUNY/Buffalo is an Equal Opportunity/Affirmative Action Employer. We are interested in identifying prospective minority and women candidates. No person, in whatever relationship with the State University of New York at Buffalo shall be subject to discrimination on the basis of age, creed, color, handicap, national origin, race, religion, sex, marital or veteran status.

PENNSYLVANIA

BRYN MAWR COLLEGE Department of Mathematics

Applications are invited for positions in Mathematics and Computer Science, starting September 1993. They should be sent to the appropriate committee, Department of Mathematics, Bryn Mawr College, Bryn Mawr, PA 19010.

MATHEMATICS POSITIONS: One tenure track assistant professorship and one three-year renewable lectureship. Candidates must have completed a doctorate in a mathematical science by the starting date, and must show promise in research and a serious commitment to undergraduate and graduate teaching. All fields are acceptable, with a preference for applied mathematics or geometry. Please send a vita, research plan and three letters of recommendation to the Mathematics Search Committee.

COMPUTER SCIENCE POSITION: Three-year renewable lectureship. Candidates should have completed a doctorate in computer science or a related field by the starting date, and must display a commitment to both teaching and scholarship, and an interest in curriculum development in a joint program with Haverford College. Please send a vita and three letters of recommendation to the Computer Science Search Committee.

Bryn Mawr College is an equal opportunity affirmative action employer. The college wishes particularly to encourage applications from individuals interested in joining a multicultural/international academic community. Minority candidates and women are especially encouraged to apply. **CLOSING DATE:** 1 January 1993 (late applications may be considered). Telephone: (215)526-5348. Email: msearch@cc.brynmawr.

CARNEGIE MELLON UNIVERSITY Department of Mathematics

The Department expects to make two or more tenure-track appointments, to begin in the Fall of 1993, at the Assistant Professor level. We seek candidates in areas of research which strongly intersect those of the current faculty of the Department. Applicants should send a vita, list of publications, and a statement describing current and planned research, and arrange to have at least three letters of recommendation sent to the committee. All communications should be addressed to: Tenure-track Appointments Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon University is an Affirmative Action/Equal Opportunity Employer.

CARNEGIE MELLON UNIVERSITY CENTER FOR NONLINEAR ANALYSIS Department of Mathematics

The Center for Nonlinear Analysis expects to make four to five Post-Doctoral appointments for 1992-1993 in the area of applied anal-

ysis. This is a one-year (twelve-month) joint appointment by the Center and Department of Mathematics. Recipients will teach at most one course per semester. Applicants should send a vita, list of publications, a statement describing current and planned research, and arrange to have at least three letters of recommendation sent to the committee. The deadline for application is January 20, 1993; late applications may be considered on a space-available basis. All communications should be addressed to: Post-doctoral Appointments Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon University is an Affirmative Action/Equal Opportunity Employer.

CARNEGIE MELLON UNIVERSITY Department of Mathematics

The Department invites applications for a senior level appointment in Computational Mathematics/Numerical Analysis. We are particularly interested in candidates who will enhance existing computational and analytical programs which involve continuum models in fluid dynamics, mechanics of solids including microstructure, phase transitions as well as other aspects of materials science. Applicants should send a vita, list of publications, and a statement describing current and planned research, and arrange to have at least three letters of recommendation sent to: Computational Mathematics Search Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon University is an Affirmative Action/Equal Opportunity Employer.

CARNEGIE MELLON UNIVERSITY Zeev Nehari Assistant Professorship in Mathematics

The Zeev Nehari Assistant Professorships have been instituted in the Department of Mathematics of Carnegie Mellon University to honor the memory of Professor Zeev Nehari, a member of the Department from 1954 to his death in 1978. The position available is for an initial period of one or two academic years, beginning in September 1993, and extendable for one additional year when mutually agreeable. It carries a reduced academic year teaching load of six hours per week during one semester and three hours per week during the other. Applicants are expected to show exceptional research promise, as well as clear evidence of achievement and should have research interests which intersect those of current faculty of the Department. Applicants should send a vita, list of publications, and a statement describing current and planned research, and arrange to have three letters of recommendation sent to the committee. All communications should be addressed to: Appointments Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon University is an Affirmative Action/Equal Opportunity Employer.

CARNEGIE MELLON UNIVERSITY

Richard J. Duffin

Assistant Professorship in Mathematics

The Richard J. Duffin Assistant Professorship was established in 1990 to honor Professor Emeritus Duffin. The position available is for an initial period of one or two academic years, beginning in September 1993, and extendable for one additional year when mutually agreeable. It carries a reduced academic year teaching load of six hours per week during one semester and three hours per week during the other. Applicants are expected to show exceptional research promise, as well as clear evidence of achievement and should have research interests which intersect those of current faculty of the Department. Applicants should send a vita, list of publications, and a statement describing current and planned research, and arrange to have three letters of recommendation sent to the committee. All communications should be addressed to: Appointments Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon University is an Affirmative Action/Equal Opportunity Employer.

TENNESSEE

EAST TENNESSEE STATE UNIVERSITY

**Mathematics Department
Johnson City, Tennessee
Faculty Vacancy**

Mathematics Department of East Tennessee State University invites applications for a tenure-track position with rank of Assistant Professor available 8/93. Applicants must hold an earned doctorate and be able to demonstrate excellence in teaching and have an active, ongoing program of research. Although candidates from all areas of mathematics will be considered, preference will be given to a person with training and research in applied statistics. Proficiency in spoken English is required. ETSU employs only U.S. citizens, permanent residents, and aliens authorized to work in the U. S. Rank and salary commensurate with qualifications and experience.

East Tennessee State University is a comprehensive university of 12,000 students nestled in the hills and mountains of scenic East Tennessee. Residents enjoy a wholesome climate marked by four distinct, but moderate seasons.

Review of applicants will begin October 1992 and continue until the position is filled. Send letter of application, resume, and have four letters of professional reference sent to: T. Henry Jablonski, Jr., Chair, Search Committee, Department of Mathematics, ETSU, Box 70663, Johnson City, TN 37614-0663. Phone 615-929-6973.

Applicants who do not hold a current, full-time faculty appointment as indicated on the resume must also submit transcripts. Women and minorities are encouraged to apply. AA/EEOE

THE UNIVERSITY OF THE SOUTH

**Department of Mathematics
and Computer Science**

Tenure-track position in mathematics, to begin Fall 1993, at a highly selective church-related (Episcopal) liberal arts college of 1100 students located on a 10,000-acre forested domain in the Tennessee uplands. Applicants should have an appreciation for the liberal arts and some interest in computing. Applications from women and minorities are especially encouraged. The position is at the level of assistant professor, with excellence in teaching and continued interest in research expected. A complete application will include a letter stating one's professional aims, a resumé, graduate and undergraduate transcripts, and three recommendations. All should be sent to Sherwood F. Ebey, The University of the South, 735 University Avenue, Sewanee, TN 37375-1000. Applications received by November 27 will have first consideration. AA/EEOE.

TEXAS

SOUTHERN METHODIST UNIVERSITY

Department of Mathematics

The Department of Mathematics at Southern Methodist University invites applications for a senior level tenure track position, with employment beginning in Fall 1993. Applicants must have demonstrated leadership in research in applied mathematics, must have a strong commitment to high quality undergraduate and graduate teaching, and must be ready and qualified to offer supervision in some area of the doctoral program in physical applied mathematics, numerical analysis and scientific computation. A strong grant record would be advantageous. The standard teaching load is two courses (six hours) per semester.

Departmental research interests include asymptotic and perturbation methods, bifurcation theory, combustion theory, dynamical systems, fluid mechanics, mathematical biology, mathematical software, nonlinear waves, and numerical analysis of differential equations. Thirteen of the sixteen faculty are applied mathematicians. Senior faculty include W.E. Ferguson (numerical partial differential equations), I. Gladwell (mathematical software), R. Haberman (perturbation methods and nonlinear waves), M.V. Melander (computational fluid dynamics), G.W. Reddien (numerical bifurcation theory), D.A. Reinelt (fluid mechanics), and L.F. Shampine (numerical ordinary differential equations).

The application deadline is October 15, 1992. Send a letter of application and a vita to: Professor I. Gladwell, Chairman, Department of Mathematics, Southern Methodist University, Dallas, TX 75275; tel: 214-692-2506.

I. Gladwell's email addresses: gladwell@csvax.seas.smu.edu; h5nr1001@smuvm1.bitnet; or h5nr1001@vm.cis.smu.edu.

SMU is an equal opportunity/affirmative action/Title IX employer.

TEXAS A&M UNIVERSITY

Head, Department of Mathematics

Texas A&M University is a major coeducational institution, serving over 40,000 students, and ranks in the top ten nationally in research funding, number of National Merit Scholars, and value of its permanent endowment. The College of Science has a research and teaching budget of approximately \$40,000,000 and comprises the Departments of Biology, Chemistry, Mathematics, Physics, and Statistics and the Cyclotron Institute. The Mathematics Department is large, energetic, and committed to excellence. Its dynamic faculty, representing pure and applied mathematics, is actively involved in research and both graduate and undergraduate education.

The position of Head will be filled by a person with an outstanding record of achievement in research and teaching and with demonstrable administrative skills. Effective communication, a talent for management, and ability to provide visionary leadership are especially important.

Applications, consisting of a resume and the names of five persons from whom we may request letters of reference, will be accepted until November 1, 1992, or until the position is filled. Women and minorities are especially encouraged to apply.

Texas A&M University is an equal opportunity, affirmative action employer:

Respond to: Dr. Jon Pitts, Chair
Mathematics Department Head Search
Committee
College of Science
Texas A&M University
College Station, TX 77843-3257
Phone: 409-845-7361
FAX: 409-845-6077
Email: search@math.tamu.edu

VIRGINIA

WASHINGTON AND LEE UNIVERSITY

**Department of Mathematics
Lexington, VA 24450**

RADFORD PROFESSOR / DEPARTMENT HEAD. The Radford Chair of Mathematics will be filled in September 1993. An applicant should have a background that warrants tenure and the rank of full professor, a record of effective teaching and scholarship, and a commitment to mathematics education in a liberal-arts setting. The Radford Professor will assume the position of department head for a five-year term.

The mathematics faculty numbers seven, all with Ph.D.s. The University is primarily a liberal-arts college with 1600 undergraduates. It is 240 years old and is located in the lower Shenandoah Valley. Address inquiries to Prof. T. O. Vinson, Search Committee, Mathematics Department. The selection process will begin in November 1992. AA/EEOE.

Classified Advertisements

CANADA

UNIVERSITY OF TORONTO Department of Mathematics

The Department solicits applications for a tenure-stream appointment in Analysis. Preference will be given to researchers in the areas of non-linear analysis and geometric analysis. The appointment is at the Erindale campus at the level of Assistant Professor, to begin July 1, 1993. Candidates are expected to have at least three years experience in teaching and research after the Ph.D., and to be able to demonstrate excellence in each. In particular, a candidate's research should show clearly the ability to make significant original and independent contributions to Mathematics. Applicants should send their complete C.V. including a list of publications and any appropriate material about their teaching, and arrange to have at least four letters of reference sent directly to Professor J. Repka, Associate Chair, Department of Mathematics, University of Toronto, Toronto, Canada M5S 1A1. At least one letter should deal with the candidate's teaching. To insure full consideration, this information should be received by October 31, 1992. The University of Toronto encourages both women and men to apply. In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents.

UNIVERSITY OF TORONTO Department of Mathematics

The Department solicits applications for a tenure-stream appointment in Analysis. Preference will be given to researchers in the areas of harmonic analysis, geometric analysis, and differential equations.

The appointment is at the downtown (St. George) campus at the level of Assistant Professor, to begin July 1, 1993. Candidates are expected to have at least three years experience in teaching and research after the Ph.D., and to be able to demonstrate excellence in each. In particular, a candidate's research should show clearly the ability to make significant original and independent contributions to Mathematics.

Applicants should send their complete C. V. including a list of publications and any appropriate material about their teaching, and arrange to have at least four letters of reference sent directly to Professor K. Murty, Associate Chair, Department of Mathematics, University of Toronto, Toronto, Canada M5S 1A1. At least one letter should be primarily concerned with the candidate's teaching. To insure full consideration, this information should be received by December 31, 1992.

The University of Toronto encourages both women and men to apply.

UNIVERSITY OF TORONTO Department of Mathematics

The Department solicits applications for a tenure-stream appointment in Geometric Analysis. The position is subject to budgetary approval.

The appointment is at the downtown (St. George) campus at the level of Assistant Professor, to begin July 1, 1993. Candidates are expected to have at least three years experience in teaching and research after the Ph.D., and to be able to demonstrate excellence in each. In particular, a candidate's research should show clearly the ability to make significant original and independent contributions to Mathematics. Salary commensurate with qualifications.

Applicants should send their complete C.V. including a list of publications and any appropriate material about their teaching, and arrange to have at least four letters of reference sent directly to Professor K. Murty, Associate Chair, Department of Mathematics, University of Toronto, Toronto, Canada M5S 1A1. At least one letter should be primarily concerned with the candidate's teaching. To insure full consideration, this information should be received by December 31, 1992.

The University of Toronto encourages both women and men to apply. In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents.

UNIVERSITY OF TORONTO Department of Mathematics

The Department solicits applications for a tenure-stream appointment in Applied Mathematics. Preference will be given to researchers in the areas of probability and nonlinear partial differential equations. The position is subject to budgetary approval.

The appointment is at the downtown (St. George) Campus at the level of Assistant Professor, to begin July 1, 1993. Candidates are expected to have at least three years experience in teaching and research after the Ph.D., and to be able to demonstrate excellence in each. In particular, a candidate's research should show clearly the ability to make significant original and independent contributions to Mathematics. Salary commensurate with qualifications.

Applicants should send their complete C.V. including a list of publications and any appropriate material about their teaching, and arrange to have at least four letters of reference sent directly to Professor K. Murty, Associate Chair, Department of Mathematics, University of Toronto, Toronto, Canada M5S 1A1. At least one letter should be primarily concerned with the candidate's teaching. To insure full consideration, this information should be received by December 31, 1992.

The University of Toronto encourages both women and men to apply. In accordance with Canadian immigration requirements, priority will

be given to Canadian citizens and permanent residents.

ENGLAND

THE UNIVERSITY OF SUSSEX Lectureship in Mathematics

Applications are invited for a permanent Lectureship in Mathematics from January or October 1993 or such date as can be agreed. The appointee is expected to have research interests in the general area of Algebra/Topology/Geometry, and interact with existing faculty in these fields, but outstanding candidates, with research interests in the areas of Analysis, Statistics or Applied Mathematics already represented at Sussex should also apply.

It is intended to make the appointment on the Lecturer A scale (£12860-£17827, under review). Further particulars and application forms may be obtained from Paula Boyle, Personnel Office, Sussex House, University of Sussex, Falmer, Brighton BN1 9RH, Tel (0273) 678202. Completed forms should be returned by **23 October 1992**.

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FOR SALE

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PUBLICATIONS FOR SALE

MATH SCI PRESS, 53 Jordan Rd., Brookline, MA 02146, 617-738-0307. **Geometric Structures and Nonlinear Physics**, \$95. **Geometric Computing Science**, \$85, both by R. Hermann. To appear: **Lie Theory and Generalized Function Algebras**.

PUBLICATIONS WANTED

Wanted: Mathematical books, journals, reprints, ephemera. Contact R. K. Dennis, Math. Dept., White Hall, Cornell U., Ithaca, NY 14853-7901. Tel: 607-255-4027, FAX: 607-255-7149. email: dennis@mssun7.msi.cornell.edu

MATHEMATICAL REVIEWS

ASSOCIATE EDITOR - HALF-TIME

Applications and recommendations are invited for a one- or two-year half-time appointment as an Associate Editor of *Mathematical Reviews* (MR), to commence in January 1993. Applications will be welcome from persons taking leave from other positions and in particular from tenured faculty members who can take leave to come to MR for one or two years.

The MR office of the American Mathematical Society is located in Ann Arbor, Michigan, not far from the campus of the University of Michigan. The editors, although employees of the AMS, enjoy many privileges at the University. At present, MR employs fourteen mathematical editors, about six consultants, and over sixty nonmathematicians. It produces *Mathematical Reviews*, *Current Mathematical Publications*, various indexes, the on-line service MathSci and MathSci Disc. The responsibilities of an Associate Editor fall primarily in the day-to-day operations of selecting articles and books suitable for review, classifying these items, assigning them to reviewers, editing the reviews when they are returned, and correcting the galley proof. An individual with considerable breadth in pure or applied mathematics is sought and preference will be given those applicants with expertise in numerical analysis. The ability to write good English is essential and the ability to read mathematics in major foreign languages is important. (The ability to read mathematical articles in Russian or Chinese is especially desirable.)

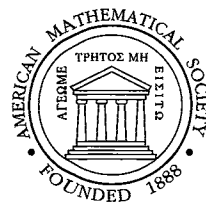
Persons interested in combining a sabbatical or other leave with this half-time appointment as an Associate Editor are encouraged to write (by letter or email) for further information. The twelve-month salary is negotiable and will be commensurate with the experience the applicant brings to the position.

Applications (including curriculum vitae, bibliography, and names and addresses of at least three references) should be sent to

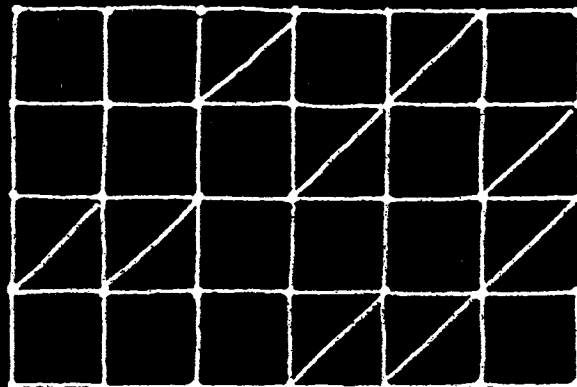
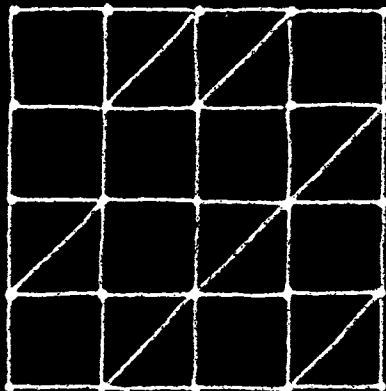
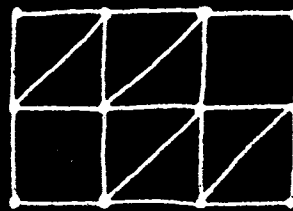
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Interested applicants are urged to inquire without delay.

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THE UNIVERSITY OF AUCKLAND - NEW ZEALAND
Department of Mathematics and Statistics
A CHAIR IN PURE MATHEMATICS

Vacancy UAC.197

Applications are invited for a Chair of Pure Mathematics. The successful applicant will have an outstanding academic and research background in some branch of Pure Mathematics with personal qualities and experience which will enable her/him to contribute significantly to the continuing development of Pure Mathematics at Auckland both in research and teaching.

This position, is one of four established Chairs in the Department of Mathematics and Statistics, two being in Pure Mathematics and one in each of Applied & Computational Mathematics and statistics. Three other staff hold Personal Chairs. The Department has research strength in a number of areas of Pure Mathematics, including logic, group theory, discrete mathematics, finite geometry, functional analysis, summability theory, complex analysis, quasiconformal analysis, topology and differential equations.

The Department of Mathematics and Statistics at the University of Auckland is the largest Department of the largest University in New Zealand. It is in the process of boosting its graduate student enrolments. The Department has an undergraduate computing laboratory currently being enlarged and has a collection of Macintosh microcomputers and Sun workstations. The Pure Mathematics collection of periodicals in the University Library is the best in the country and includes a number of journals obtained by exchange with the New Zealand Journal of Mathematics (formerly known as the Mathematical Chronicle), produced locally in collaboration with the New Zealand Mathematical Society.

Commencing salary will be established within the range NZ\$80,080 - NZ\$94,840 per annum.

Further information, Conditions of Appointment and Method of Application, should be obtained from the Assistant Registrar, Academic Appointments, The University of Auckland, Private Bag 92019, Auckland, New Zealand, telephone (64) 9 373-7999, fax (64) 9 373-7454. **Three copies** of applications should be forwarded to reach the Registrar by 20 November 1992.

Please quote Vacancy Number UAC.197 in all correspondence.

W B NICOLL, REGISTRAR.

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OKLAHOMA STATE UNIVERSITY
Grayce B. Kerr Chair in Mathematics



The Department of Mathematics invites applications and nominations for the Kerr Chair in Mathematics. Candidates should have an outstanding record of scholarly accomplishments and a strong commitment to research. The person selected to fill this position will be expected to maintain a strong research program and be actively involved in the development of the department, including the graduate and undergraduate programs. Salary, discretionary fund, and teaching load are negotiable.

Send inquires, nominations, and applications to:

Alan Adolphson
Chairman, Chair Search Committee
Department of Mathematics,
Oklahoma State University
Stillwater, Oklahoma 74078
Email: adolphson@math.okstate.edu

For full consideration, applications should be received by November 1, 1992. Applications should include a vita and names and addresses of references. Oklahoma State University is an affirmative Action/Equal Opportunity Employer. Women and minorities are encouraged to apply.



**MASSEY
UNIVERSITY**

PROFESSOR OF PURE MATHEMATICS

**Department of Mathematics
School of Mathematical and
Information Sciences**

Applications are invited for a newly-established Chair in Pure Mathematics within the Department of Mathematics. The Department is one of four in the School of Mathematical and Information Sciences which comprises the Departments of Mathematics, Computer Science, Information Systems and Statistics. This Chair is designed to provide leadership in research and teaching in the more theoretical branches of mathematics. The other established Chair in Mathematics is held by Professor Graeme C Wake who is also currently Head of Department.

The appointee will be expected to provide direction within the Department, University, and in the wider community. Applicants should be distinguished in research in one or more fields of Pure Mathematics and have proven ability in teaching. The appointee will be expected to take a full part in teaching, research and administration and may be expected to serve a term as Head of Department. It is envisaged that the appointee would take up the Chair in 1993.

The Department of Mathematics offers a full undergraduate programme in mathematics including service teaching. Most undergraduate courses are taught both to internal students and by correspondence to extramural students throughout New Zealand and overseas. The graduate study programmes include masterate and PhD thesis supervision - currently for fifteen students.

The University reserves the right to make no appointment or to fill the Chair by invitation.

Reference number NAMS 54/92 must be quoted.

Closing date: 31 October 1992.

Further details of the above position together with Conditions of Appointment are obtainable from Mrs V B Bretherton, Personnel Section, to whom applications, including a full curriculum vitae, and the names, addresses and fax numbers of three referees should be sent before the closing date specified.

B.R.H. Monks
Registrar

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Fax (64) 6 350-5615**

National University of Singapore



Faculty of Science

Applications are invited for faculty positions/appointments in one of the following disciplines from candidates who must possess a relevant PhD degree. Preference will be given to those who are able to teach in more than one of the areas listed under the discipline they are applying to and with proven ability in research.

MATHEMATICS

Pure Mathematics • Applied Mathematics • Operations Research • Statistics

COMPUTATIONAL SCIENCE PROGRAMME

Computational Mathematics—Applicants should specialize in either geometric modelling or statistical computing. Experience with UNIX graphics workstations is essential.

Besides appointments on normal 3-year contracts, visiting appointments for one or two years will also be considered.

Gross annual emoluments range as follows:

Lecturer	S\$50,390–64,200
Senior Lecturer	S\$58,680–100,310
Associate Professor	S\$88,650–122,870
(US\$1.00 = S\$1.62 approximately)	

The commencing salary will depend on the candidate's qualifications, experience and the level of appointment offered.

Leave and medical benefits will be provided. Depending on the type of contract offered, other benefits may include: provident fund benefits or an end-of-contract gratuity, a settling-in allowance of S\$1,000 or S\$2,000, subsidised housing at nominal rentals ranging from S\$100 to S\$216 p.m., education allowance for up to three children subject to a maximum of S\$16,425 per annum per child, passage assistance and baggage allowance for the transportation of personal effects to Singapore. Staff members may undertake consultation work, subject to the approval of the University, and retain consultation fees up to a maximum of 60% of their gross annual emoluments in a calendar year.

There are eight faculties in the National University of Singapore with a current student enrolment of some 18,000. All departments are well-equipped with a wide range of facilities for teaching and research.

All academic staff have access to the following computer and telecommunication resources: an individual microcomputer, an IBM 3090 mainframe, an NEC SX supercomputer, on-line library catalogue, all networked through optical fibre based FDDI technology. International contact is maintained through BITNET and INTERNET. In addition, the Computational Science Laboratory is equipped with a SUN parallel processing and scientific visualization platform and two clusters of DECstation 5000 workstations.

Application forms and further information on terms and conditions of service may be obtained from:

**The Director
Personnel Department
National University of Singapore
10 Kent Ridge Crescent
Singapore 0511**

Enquiries may also be sent through BITNET to: PERPL @ NUS3090, or through Telefax: (65)7783948

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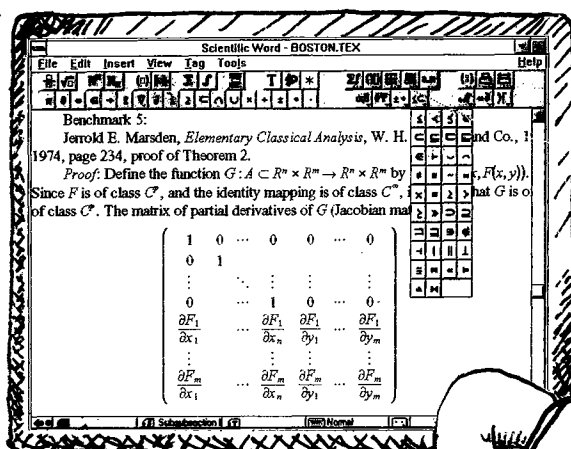
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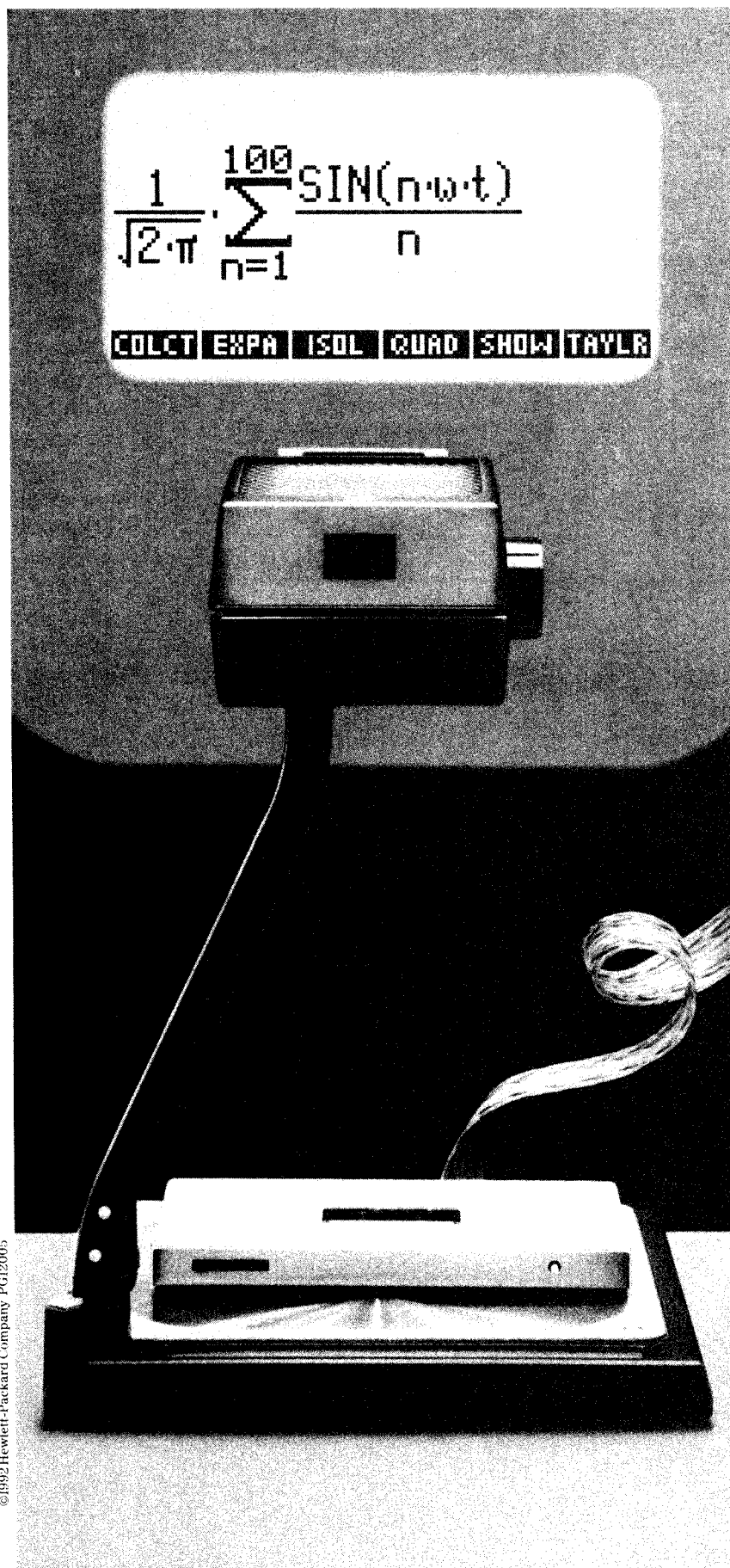
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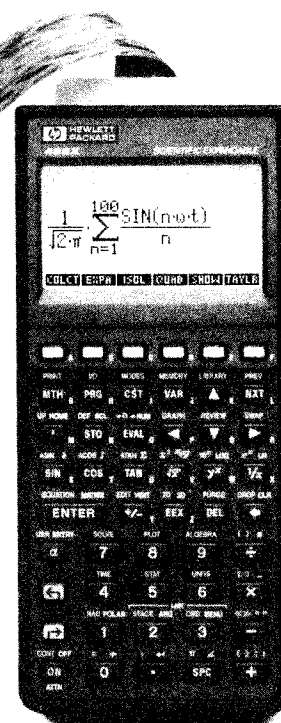
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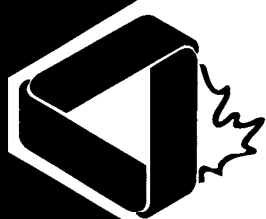
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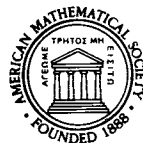
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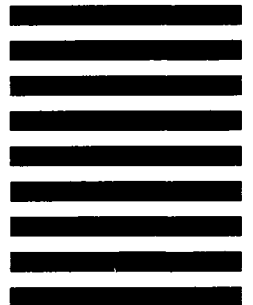
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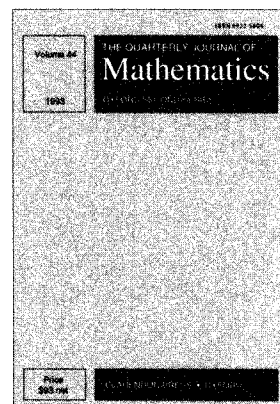
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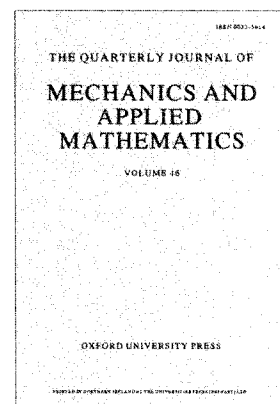
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